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TECHNOLOGY IN AMERICAN EDUCATION, 1650-1900.

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THIS STUDY IS ONE OF SEVERAL WHICH EXAMINED THE HISTORY AND BACKGROUND OF INSTRUCTIONAL TECHNOLOGY IN AMERICAN EDUCATION. IT COVERED EDUCATIONAL TECHNOLOGY DEVELOPMENT THROUGH THE END OF THE 19TH CENTURY, BUT EMPHASIZED THE 19TH-CENTURY PERIOD. TECHNOLOGICAL DEVELOPMENTS OTHER THAN CONVENTIONAL AUDIOVISUAL DEVICES INVOLVING PHOTOGRAPHY AND SOUND TECHNIQUES WERE INCLUDED. (LP)

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NEW MEDIA FOR INSTRUCTION 1

Technology in American Education 1650–1900

By CHARNEL ANDERSON

for the Technological Development Project of the National Education Association of the United States

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Foreword

This study, one of several which are examining the history and background of instructional technology in American education, was done by Mr. Charnel Anderson, a graduate student in the Department of History, George Washington University, Washington, D. C. Mr. Anderson's assignment was to examine the history of technological developments in instruction to the end of the 19th century and with emphasis upon the 19th century period.

This period was chosen rather arbitrarily to cover technological developments other than conventional audio-visual devices involving photography and sound techniques. While it is true that photography, sound recording, etc., have an extensive history even antedating the 19th century, their application in education in America has been most marked in the last sixty years. These developments will be the subject of another paper to be published.

In developing this brief report Mr. Anderson used the facilities of the Library of Congress, the library of the U. S. Office of Education, the NEA archive collection, and several university libraries. Because of the scope of coverage required in a short time, he was requested to use secondary sources where they would prove useful. However, as will be noted from the report, he was able to delve extensively into first-hand materials. Material developed from these primary sources proves to be some of the most interesting in this report.

No claim is made that we have produced a definitive history of instructional technology in American education. Rather, we present here the skeleton of that portion of this history which deals with (with some minor exceptions) technological developments other than projection and recording.

Such an historical analysis, however, has its uses in connection with the primary purpose of the Technological Development Project, which is to detect trends in the confused technological present and attempt to do some forecasting so that American education may have some guidelines for the future. Without involving the various theories of history, it still remains obvious that the past has some relation to the present and future. A reading of Mr. Anderson's report should make this abundantly clear.

JAMES D. FINN

Los Angeles
July, 1961

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Technology in American Education, 1650–1900

Part I

COLONIAL PERIOD
(1600's–1700's)

This period is labeled as the pre-industrial era in technology. Production was centered around highly specialized artisans and skilled workers. Work was done by hand and even the most efficient form of production involved some sort of crude home-manufacturing arrangement. Late in the 1770's (about the same time the American colonial period was drawing to a close) there began to be rumblings of the Industrial Revolution; specific machines were invented to replace the artisan, and the factory system began to take form.

Educational technology was also in a pre-industrial state during this period. Instructional apparatus such as quill, ink, and the hornbook were only handwork products that could be produced by a semi-skilled worker in a very short time. Textbooks, more dependent upon advanced technology than other school implements, were in a crude state. Circulation was fairly limited, textural and illustrative material was poor, and prices were high. A quick survey of these and other educational tools will offer convincing proof that technology had made very few inroads in the field of education during the American colonial period.

School Architecture

School architecture is only an outward expression of the internal development in education. In the days of our forefathers, the educational program was simple, consisting primarily of the three R's. Thus a one-room building was sufficient to house students and the educational equipment needed.

The school building was crudely built of logs placed directly on the ground or on blocks about 2½ feet high; the space underneath serving as a rendezvous for hogs and chickens. If built on the ground, there

was usually no floor, the bare earth being problematical to the schoolmaster as "the youngsters would purposely stir up their dust in clouds to annoy the teacher and amuse their fellows.[1] The other type of building had a rough puncheon flooring of split and/or hewn logs with roofs made of bark. There were one or two windows, made of paper greased with lard to make the paper both transparent and waterproof.

Occasionally the schoolmaster enjoyed the luxury of a frame building built with saw-milled lumber. This occurred when a community outgrew their church or meetinghouse. The school then inherited a building which was decidedly superior to the rustic log houses. Such was the case in a Connecticut town in 1664 where a meetinghouse had been used for a decade or more, and then given to the schoolmaster who used it for an additional thirty years.

It is important to remember that the colonial log schoolhouse was a frontier development; as the frontier moved across the mountains, the log school went with it. The frontier disappeared slowly and unevenly from the American scene and the log schoolhouse took a long time to disappear.[2] This means that advancing technology was to have only a spasmodic impact on school architecture. The log structures in the Mississippi Valley frontier were just as advanced in their own technological setting as their contemporary brick school buildings being built in Boston.

School Furniture

The school furniture tended to be even more crude than the buildings. Sticks were inserted between the logs that comprised the side of the building; boards were nailed on top of the sticks and in this way, the early desks were made.[3] Benches were made of backless split logs that ran the entire length of the desks. A school furniture catalogue of 1870[4] gives an interesting account of how the problem of seating both large and small children was solved:

> The primeval School Furniture of which we have accounts, consisted of a bench with legs long at one end and short at the other. The large scholars sat upon the higher end, and the smaller pupils were graded down to the lower end, according to their respective sizes.

A rather primitive concept of graded school furniture.

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[1] Clifton Johnson, *Old-Time Schools and School Books*, New York, The MacMillan Co., 1925, p. 36.

[2] As late as 1890 in West Virginia, out of a total of 4,814 school buildings in the state, 1,007 were log structures.

[3] Johnson, *op. cit.*, p. 36.

[4] Boston School Furniture Co., *Illustrated Catalogue*, Boston, Solon Thornton, Printer, 1870.

Instructional Apparatus: Quills, Ink, Paper

The colonial schools had no blackboards, slates, or maps, although some flourishing schools could boast of owning a globe. Almost all of the school supplies for pupils were homemade. The pens were goose-quills. In fact, a teacher was sometimes hired more for his ability to cut and mend quills than for his ability to teach. If the schoolmaster was an expert penmaker, a great deal of his time would be consumed in that activity if he had a large school.

Each family supplied their children with homemade ink, usually by dissolving ink powder in water. Many of the country folk gathered the bark of swamp-maple and boiled it down for ink. These homemade inks were often weak and pallid and sometimes dried up.

The paper ordinarily bought for school purposes was rough and dark. Its high cost led the scholars to use it sparingly and in the new and poorer communities children frequently had to write on birch bark. The paper came in foolscap size (approximately 13″ x 17″) and was unruled. The pupils would fold the paper and make separate pages out of it, cover the pages with a coarse brown wrapping paper or wallpaper, and then carefully sew it into a "copy-book" or "sum-book." [8]

Once the copy book was made, the children had to rule the paper in preparation for writing. This was done with little strips of sheet lead or "leaden plummets" as they were called. Regardless of the primitive equipment, however, the handwriting of the colonial children seemed to suffer no visible damage.

The Hornbook

This teaching apparatus was peculiar to the colonial period, disappearing about the same time as the start of the Revolutionary War. The hornbook was the first book used to teach children to read, and was their first introduction to formal education.

The hornbook—not really a book at all—was an ingenious solution to the problem of letting small children have free use of something relatively valuable. At that time, literary material for school children was a luxury. The precious one-page manuscript with the alphabet on it was fastened to a piece of board and covered with a thin, transparent sheet of horn. A light strip of metal, usually brass, was tacked around the edge of the horn to hold it in place. The horn prevented

[8] Johnson, *op. cit.*, pp. 39–40.

1. Illustration from Webster: Blue-Back (portrait of Noah Webster) showing poor quality of early illustrative material -from Clifton Johnson's Old Time Schools and School Books. New York (1935) p. 173.

In the Name of the Father, and of the Sonne, and of the holy Ghost. Amen.
Our Father which art in heauen, hallowed bee thy Name. Thy Kingdome come. Thy will be done in earth as it is in heauen. Giue vs this day our daily bread. And forgiue vs our trespasses, as we forgiue them that trespasse vs. And lead vs not into temptation: but deliuer vs from euill: Amen.

Horn-Book from Luer, History of the Horn-Book, London (1896) Vol. II, p. 6 (Illustration).

the paper from being soiled and thumbed to pieces by frequent use.[6]

At the top of the paper which comprised the hornbook, the alphabet was usually written in capital and small letters. Underneath, either numerals or sometimes vowels and consonants were printed. Almost invariably at the bottom was the Lord's Prayer.

The use of the hornbook in America was a direct import from the English educational system. It had been used in England ever since the 1400's, although it had never made inroads on the Continent where a simple engraving of the alphabetical tables was used—without the protective horn.[7] The hornbook reached its peak of popularity in the 16th and 17th centuries, and it is interesting to note the references to it in English literature. Ben Johnson wrote:

> The letters may be read through the horn. That makes the story perfect.

Shakespeare refers to it in discussing Holofernes, the schoolmaster, in *Love's Labour's Lost:* "He teaches boys the Hornbook."[8]

The Pilgrim fathers probably brought hornbooks to America with them on the Mayflower; it is certain that they were in constant use during colonial days and shortly after the revolution. Many references are made to them in American literature. As late as December 7, 1760, the *Pennsylvania Gazette* advertised "gilt horns and plain horns."[9]

There is evidence which indicates that hornbooks were never manufactured in the American colonies but were handled as imports from England. This supports the theory that the main reason for the disappearance of the hornbook was the influence of the Revolutionary War, which disrupted trade between England and America and resulted in a post-revolutionary reaction against everything British.[10]

Another theory is that the hornbook became modified during years of use and finally evolved into the simple primer. Later hornbooks do show improvements such as wooden slides through which different lessons could be slipped under the horn. As paper became cheaper, the A–B–C's printed on a piece of cardboard replaced the wood and horn altogether.

One obvious outgrowth of the hornbook was the "battledore book" invented by John Newbury, an Englishman, in 1746.[11] It was simply a piece of cardboard which could be folded into a two- or three-leaf book and made to stay that way by a little flap on the corner.

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[6] *American Journal of Education*, Vol. 28 (1877), p. 854.
[7] *Ibid.*, Vol. 8.
[8] *Ibid.*, p. 310.
[9] Andrew W. Luer, *History of the Hornbook*, New York. Charles Scribner's Sons, 1896, p. 136.
[10] *American Journal of Education*, Vol. 17 (1867–1869), p. 187.
[11] George A. Plimpton, "Hornbooks", *The Independent* (New York), Vol. 73 (July 31, 1912), p. 268.

Essentially, the battledores were small illustrated primers. Their simplicity made them very cheap (about a penny each for the cheapest!) and one English publisher sold more than 100,000 books in ten years. However the battledore, too, was rarely used in this country after the Revolutionary War.

Textbooks

We have seen how the hornbook and later the battledore and A–B–C primers were used during colonial times. The next big step toward the modern textbook was the spelling book, which preceded true primers by a number of years.

. The first of such spelling books was Coote's *The English School-Master*, a thin 72-page book published in 1596. According to the title page, "he which hath this Book only, needeth to buy no other to make him fit from his Letters to the Grammar-School, or for an Apprentice," [12] Not only did it contain spelling lessons but had a smattering of arithmetic, history, and a short catechism. The book was popular for over a century.

One of the first notable textbooks was Comenius', *Orbis Pictus*, first published in Nuremberg, Germany in 1657.[13] It was soon translated into fourteen languages and went through countless editions. Not only was it the standard text for German Schools for 200 years, but it enjoyed great popularity in England and the American colonies.

Comenius' *Orbis Pictus* is especially significant because it was the first illustrated schoolbook of any importance ever to be printed.[14] The *Orbis Pictus* (translated: Visible World or World Illustrated) sought to fulfill its ambitious title with "pictures of all chief things that are in the world, and of men's employment therein; in above 150 cuts." It begins by illustrating the alphabet ("The Crow Crieth"—with a wood-cut illustration of a crow) and then moved on to larger cuts of human activities. For example, one cut entitled, "The Blacksmith," shows a smith working in his shop. The tools in the shop are numbered and under the cut the objects are named and numbered:

> and thus are hammer'd out Nails, 9, Horse-shoes, 10, etc.

Orbis Pictus had more of the character of an illustrated dictionary than a child's reading book.

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[12] Johnson, *op. cit.*, p. 22.

[13] John Amos Comenius, *The Orbis Pictus*, reprinted by C. W. Bardine, Syracuse (1887), Introduction.

[14] Whether it was the first illustrated textbook as such to be printed is open to question. See Brien's article, "Notes on the Background of Visual Education," in *Education*, Vol. 61, No. 6, Feb. 1941, pp. 321–325.

Because of this book, Comenius is often credited with being the father of Visual Education. Regardless of the merits of this claim, his theories on visual education are of special interest to us.

Basically, Comenius felt that the child in his early school years was not ready for a flood of abstractions. If an object was used to present the abstractions, however, he felt children would "grow merry, wax lively and willingly suffer themselves to be fastened upon them, till the thing be sufficiently discerned." Comenius offered pictures or woodcuts in place of objects in his *Orbis Pictus*.

In the colonies, the printing of textbooks was begun early. The first printing press was assembled by Stephen Daye in 1639. Between 1641 and 1643, he printed a spelling book. It had little circulation and had no influence on the American textbook movement except for the fact that it was the first American textbook.[15]

The first American textbook of any importance—The New England Primer—was published about 1690 [16] by Benjamin Harris. Although the primer, an outgrowth of a long line of English primers, was nothing original, it immediately became an accepted textbook in New England. Every home had a copy and they were on sale in every town and village bookshop. The accounts kept by printers Benjamin Franklin and David Hall show that their firm alone sold 37,000 copies between 1749–1756; [17] undoubtedly overall sales easily ran into the hundreds of thousands.

Technologically the *New England Primer* was not very advanced. Printed from movable type, each letter had to be set by hand. Each time the book was printed in a different locality, the printer had to repeat this hand-setting process unlike today's when a publisher can make duplicate sets of plates and send them to anyone wanting to reproduce one of his books. The typography in these early editions was clear and distinct, but only because books were printed in small quantities.

The *New England Primer* was bound by hand. This was a slow process, and even the largest printers could bind only a few books a day. Covers were made from thin oak, and despite the coarse blue paper pasted over the oak, they cracked and splintered badly. The back was of leather and neither back or sides had any printing on them.[18]

Textual material was concentrated more on moral teaching than

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[15] American Textbook Publishers Institute, *Textbooks in Education*, Chicago; The Lakeside Press, 1949, p. 24.

[16] A Boston Almanac made the first written reference to it in that year in the form of an advertisement.

[17] American Textbook Publishers Institute, *op. cit.*, p. 26.

[18] Johnson, *op. cit.*, p. 74.

actual factual teaching. Thus the *New England Primer* began with the letter A:

> **In Adam's Fall**
> **We Sinned All**

Even in presenting the sciences, the opportunity for moralizing was not to be overlooked in the early texts. In the arithmetic section of *Dilworth's Schoolmaster's Assistant*, reprinted in Philadelphia, we find:

> **Three jealous husbands, each with a wife, met on a river bank. How are they to cross so that none of the wives is left in the company of one or two men unless her husband is also present?** [19]

Factual material subjects such as history left much to be desired. In a colonial primer written by a certain Fenning and appearing in 1775, a chronology of "the most remarkable Occurrences in Sacred and profane History" is recorded, including such titles as: [20]

Eleven Days successive Snow	**A.D. 1674**
A Very great Comet	**1680**
A terrible high Wind, November 26	**1703**

Illustrations in early texts were as bad as the textual material, or worse. While wood engravings had been used in Europe since 1430, and copper engravings were used as early as 1450, it was 1814 before a steel-engraving process was invented. Because of these technical limitations, illustrations were used sparingly and the drawings and engravings were very crude.[21]

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[19] William Edward Pulsifer, *A Brief Account of the Educational Publishing Business in the United States*, Atlantic City, New Jersey, 1921, p. 6.
[20] Johnson, *op. cit.*, p. 54.
[21] Pulsifer, *op. cit.*, pp. 8–9.

Part II

FROM THE AMERICAN REVOLUTION TO THE CIVIL WAR

Technological Development

THE 70-YEAR PERIOD from 1791 to 1861 was one of rapid growth for young America. In manufacturing, her mills and factories were competitive with those of Europe. Her inventive genius developed improved tools and new industrial techniques and machines. Her expansion westward resulted in a complete new communications system utilizing railroads and clipper ships and tied together by the most extensive telegraph system the world had yet seen.

Trends in Education

The Revolutionary War, which forced American industry to stand on its own feet, had a shattering effect on education. The colonial educational system was completely disrupted as teachers were summoned to the army. Schools closed down one after another.

Following the war, the nation had little time to devote to rebuilding its education system. A new government was needed. The western expansion required much of the nation's strength. It was a static period in education until about 1830, when Henry Barnard, Horace Mann, and other educators gave a new direction to education.

However, some benefits of the growing American technology did filter down to education. During this period important teaching implements such as the blackboard, slate, and maps were added. School furniture and architecture also improved.

Even more important, from about 1830 on, educators began to accept the fact that new teaching apparatuses could make invaluable contributions to the educational field. Reformers like Mann and Barnard began to require their schools (in Massachusetts and Connecticut, respectively) to report regularly on apparatuses acquired and their use.

There was a substantial change underway. William J. Adams, lecturing to a teachers convention at Boston in August 1830 told them:

> Sensible objects, judiciously selected, and properly exhibited to the young student, are found to contribute wonderfully to his advancement in all good

> learning. In fact, books and lectures, without these means of illustration, are precept without example; theory without practice; uninteresting, hard to understand, and soon forgotten. . . . The world is full of apparatus,—but the teacher, in times past, has been too slothful, or too dogmatical, even to point to it.[1]

On September 3, 1838, a meeting was held at Hanover, Massachusetts, to study the question of a normal school for Plymouth County. Present were such illustrious figures as Horace Mann, George Putnam, John Quincy Adams, and Daniel Webster. Mr. Webster commented:

> We teach too much by manuals, too little by direct intercourse with the pupil's mind; we have too much of words, too little of things. Take any of the common departments, how little do we know of the practical detail, say geology. It is taught by books. It should be taught by excursions in the field. So of other things.[2]

Two years later, in his Second Annual Report as Secretary of the Board of Commissioners of Common Schools in Connecticut, Henry Barnard was critical of his state for not utilizing teaching apparatuses more effectively:

> The importance of teaching by visible illustration and real objects, in order to give distinctness to the knowledge conveyed, and to vary the ordinary exercises, is not duly appreciated. Teachers are unacquainted with the use and application of the various school apparatus.[3]

At the same time there were critics of these innovations in education. Some felt too much technology was being introduced too fast:

> "Observe," says a third, "the spirit of the age? In these mechanical labor-saving times, we must have a MILL in which to GRIND scholars;—something in which the moving power is no longer the unfailing stream of patient, sound instruction;—a Machine, in fact, which steam may turn, and a child direct?"[4]

This writer continued to heavily criticize advocates of a "teaching machine."

Often one of the biggest criticisms against more technical instructional apparatuses revolved around their expense. It was almost useless for teachers to point out that the efficiency of these new educational tools made them more economical in the long run, as did a school visitor in Killingly, Connecticut, in 1841:

> We have no globes or other apparatus of any kind. Here we can but observe the penuriousness, or to give it its right name, the wastefulness of

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[1] William J. Adams, "Lecture on the Construction and Furnishings of School Rooms; and on School Apparatus," *American Institute of Instruction*, Aug. 1830 (Boston), pp. 344–345.

[2] *American Journal of Education*, Vol. I (1856), p. 590.

[3] *Connecticut Common School Journal*, May 1840, p 207.

[4] *American Institute of Instruction*, August 1830, p. 335. (Emphasis is the author's.)

> parents in neglecting to furnish their children with suitable materials to facilitate their progress and thereby create in the end a great saving both in time and expense. . . . Although we may not at first sight discover it, still it is a fact that the penurious parent is altogether unwise if he neglects to furnish his children within the very best means in his power to facilitate their advance in learning. For example, if the scholar can learn geography twice as fast with the aid of globes, we must consider it bad economy in those parents who refuse to furnish them on account of the expense.[5]

However, some innovations were introduced prior to the Civil War.

School Architecture

The Building

After the Revolutionary War, many communities had no school building of any kind. Instead, a large room in some building or even a dwelling was rented and furnished with desks.

A distinctive type of school building grew up in rural areas—the District School; so called because it was placed squarely in the center of a geographic district to serve the majority of the population. These schoolhouses were usually built at the junction of two or more roads, on worthless land, and as near the road as possible. Sometimes they formed part of a fence line. The schoolhouses seldom had enclosures or shade trees and the summer sun and winter winds had free play.[6]

The building consisted of one room. The outside was of rough clapboard sometimes painted red or yellow, but more often than not, unpainted. The room was lighted by five or six glass windows. Inside there might be a fireplace at the same end of the room as the teacher's desk or a stove in the middle of the room.

In the cities the school architecture was similar. The Lancasterian teaching method, imported from Europe, called for a one room school design. Under this method, all the students recited for one teacher who might have as many as 300 pupils. The number of pupils determined the size of the room needed, hence the size of the school building.[7]

Finally the growth in the number of students necessitated a modification into a "mixed" instructional method where one teacher taught the whole class and then the students would break up into small groups to recite for student monitors. This gave rise to the Monitorial school of the 1840's where separate small rooms for recitation were attached to the main schoolroom.[8]

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[5] *Connecticut Common School Journal*, July 1841, pp. 197–198.
[6] Clifton Johnson, *Old-Time Schools and School Books*, pp. 102–103.
[7] May Ayers, "A Century of Progress in Schoolhouse Construction," *American School Board Journal*, Vol. 54 (1917), pp. 23–25.
[8] *Ibid.*, p. 26.

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In the 1850's the German Facher teaching system of departmental teaching where the classes were divided into separate groups for instruction was introduced. The huge Lancasterian classroom was turned into an auditorium and classrooms became smaller permanent units under a single head divided either by grade or special subject. For the first time, the severely plain school building was enhanced by external ornamental architecture.

Evaluation of School Construction

The enlightened educators harshly criticized the school buildings of the time. In a report of Horace Mann to the Massachusetts Board of Education in 1846 he remarked:

> In 1837 not one-third part of the public houses in Massachusetts would have been considered tenantable by one decent family out of the poor-house or in it.[9]

However, such criticisms received little attention. In fact, this was part of the trouble. The process by which a school building was erected left little opportunity for a professional in the educational field to make his constructive criticism known. This situation is vividly described by Adams in 1830.[10]

> A school-house is to be erected. Observe the process. The affair is entrusted to a building committee;—patrons of learning indeed but wholly unpracticed in the routine of schools. These worthy men, faithful economists of the public money, proceed to calculate the greatest number of children that can exist in a given space. Each has his own favorite plan, in the very novelty of which he has found amusement, yet is courteous enough to yield something to the rest;—and thus, an edifice, monstrously inconvenient, and without unity of design, is the harmonious result.

School Furniture

Early Desks

Early desks in this period were usually only sloping shelves built against the wall on three sides of the schoolroom. These shelves were about three feet from the floor. When the scholars studied they leaned against the edge of the shelf and when they wrote they rested their exercise books on it. Under it a narrower shelf kept the books and other school belongings when not in use.[11]

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[9] *Ibid.*, p. 24.
[10] William J. Adams, "Lecture on the Construction and Furnishings of School Rooms; and on School Apparatus, *American Institute of Instruction*, Aug. 1830, p. 336.
[11] Johnson, *op. cit.*, p. 106.

Seats were long backless benches on which the pupils sat with their backs to the center of the room. Sometimes there were benches in the middle of the room from which the students recited; in other cases they stood. When the monitorial school evolved, regular desks were built in the center of the room while the recitation rooms were provided with benches attached to the wall.

Criticism of Early Desks

The inadequacies of the early school furniture naturally resulted in criticisms. A letter to the *Connecticut Common School Journal* in 1838 from a Dr. Smith furnishes a good example:

> To these wretched articles of common school furniture are we to look, in some measures, for the cause of so many distortions of the bones, spinal diseases, chronic affections, now so prevalent throughout the country.[12]

Other critics offered practical solutions to the problems.

> He [the teacher] probably has a back to his seat, and often uses it; let him make similar provisions for his pupils. . . . Some benches may be moved to the back of a desk, and those who sit on it, permitted to lean. . . . By shaving off a few legs, till the children can sit and place their feet on the floor, and lay their arms on the desk while writing . . . much comfort and good writing may be secured.[13]

The Combination Desk

This idea of letting desks serve as a back support for the bench in front, was adopted and was referred to as the combination desk. These type desks were installed in Public School #17, built in 1847, in New York City. The children sat facing each other on low benches with desks, 16 feet long, so arranged that each desk formed a back for the child sitting in front.[14]

But this type of desk construction also had its faults. There was crowding since no specific portion of the desk (or bench) was assigned to the individual student. There was interruption of the whole row of students when one pupil in the middle had to get out. The teacher had trouble getting close enough to inspect the work of the children in the middle, and finally, the desks were hard to sweep under.

These difficulties encouraged advocates of the separate or individual desk idea as early as 1830.

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[12] *Connecticut Common School Journal*, Sept. 1, 1838, p. 23.
[13] *Ibid.*, p. 14.
[14] Ayres, *op. cit.*, p. 25.

> The most modern construction appears to be that of detaching the seat occupied by each pupil both from the desk behind, and from the other seats. . . . In this way each child is INSULATED.[15]

The opponents of individual desks charged that they would be "too expensive." They were answered by a prize-winning essay on "Construction of School Houses" by a teacher who advocated separate desks not only as being more practical, but in the long run cheaper.

> In regard to the EXPENSE* of erecting separate desks, I am most decidedly of opinion that the amount of time saved by it will be more than a sufficient compensation. Anything which saves TIME saves MONEY.[16]

He calculated that 15 minutes a day would be saved in each class of 50 pupils. He then suggested that in a period of three years, the time saved would equal in money the three-year cost of food, clothing, and tuition for each pupil!

Pens, Ink, and Writing Implements

Methods of writing for the scholars continued much as they had been before the Revolutionary War. Ink was made from powder base if available. If not, home-made ink was extracted from maple bark, sumac, or oak balls soaked in vinegar. In its season, pokeberry juice was sometimes used, although its tendency to sour made it less desirable than the others.[17]

The students continued to make their own copy books although ready-made writing books were becoming cheaper. One new innovation was "copy slips," narrow slips of paper with letters which the pupils imitated. The first of these copy slips were published by the celebrated Boston schoolmaster, Caleb Bingham, in 1796.

Writing continued to be done with the goose-quill pen. The steel pen made its appearance in the late 1830's. By the early 1840's steel pens were so much in use that a writer of an article on penmanship in an educational journal had this to say:

> The somewhat extensive use of this description of pen [steel], makes it necessary to offer a few remarks in regard to them. They certainly save the time required in mending pens, and secure a great degree of uniformity in writing . . . with a little attention anyone may learn to use them in a short time.[18]

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[15] Adams, *op. cit.*, p. 342. (Emphasis is the author's.)
[16] *American Institute of Instruction*, 1831, p. 254. (Emphasis is the author's.)
[17] William S. Elsbree, *The American Teacher*, American Book Co., New York, 1939, p. 223.
[18] *Connecticut Common School Journal*, Feb. 1842, p. 38.

School Apparatuses

This period added a host of school apparatuses to the instructional process. In fact, few new ones were introduced after this until real machines such as the stereoptician, movie projectors, etc., came into use relatively recently. Most of these apparatuses were extremely simple and required very little engineering in their manufacture. And though there was knowledge as to the existence of these items, very few found their way into the average school of the times.

In 1830, a lecturer speaking on educational apparatuses made this list of essentials:[19]

1. A time-piece
2. Maps and globes
3. The blackboard
4. The abacus or numeral frame

He mentioned other things that might be desirable, mostly laboratory equipment:

1. Optical instruments
2. Air-pumps
3. Pneumatic apparatus
4. Steam engines

By 1841 a Professor Haskell listing apparatuses in use in New York schools had expanded the list to 32 items:

1. The round text copies, and copies for beginners being on binder's board and varnished.
2. The card for holding the pen.
3. The arithmetical cards of thirteen folio pages.
4. The arithmetical card with movable counters.
5. The five inch globe.
6. The three inch globe.
7. The two and a quarter-inch globe.
8. The globular revolving map of the world.
9. The maps of the United States and Europe.
10. The map of geographical terms.
11. The map to illustrate ancient history.
12. The large map of mountains.
13. The cylindrical revolving Mercator's chart.
14. The card of geometrical figures.
15. The protractor.
16. The machine to illustrate angles, chords, sines, tangents, etc.
17. Geometrical solids.
18. The planetarium.
19. The machine showing the inclination of the orbits of the planets.
20. The Tellurian.
21. A tide globe.

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[19] Adams, *op. cit.*, pp. 345–346.

22. The machine showing the earth as an oblate spheroid (was simply a globe; but to make it more expensive, it would flatten at the poles when whirled with the finger.)
23. The machine explaining the moon's roads.
24. The cellestial globe.
25. Diagram of the solar system.
26. The frame of pulleys and levers.
27. The machine for showing action and reaction.
28. The intermittent fountain (to demonstrate the phenomena of siphoning.)
29. The machine to show the resistance of the air.
30. The prism.
31. An electrical air-pump and chemical apparatus.
32. A box of family apparatus.[20]

As early as 1826, Josiah Holbrook had established an educational exchange in Boston for the sale of school apparatus. It soon developed into the Holbrook School Apparatus Manufacturing Company of Hartford, Connecticut. By 1850 the Holbrook Company was well-established and had agencies in several parts of the United States.

The Blackboard

Origin and Development in United States

The blackboard was rather slowly introduced in America. The earliest reference to one was in an arithmetic publication in 1809 in Philadelphia. A footnote explained that "the Black Board should be about 3 feet square, painted or stained with ink, and hung against the wall in a convenient place for a class to assemble around it." [21]

It seems that it was introduced in different parts of the country about the same time but independent of each other. Samuel J. May, an educational reformer in Boston schools, reports his first acquaintance with the blackboard.

> . . . in the winter of 1813–1814 . . . I attended a mathematical school kept in Boston . . . on entering his room, we were struck at the appearance of an ample Blackboard suspended on the wall, with lumps of chalk on a ledge below, and cloths hanging at either side. I had never heard of such a thing before. There it was—forty-two years ago—that I first saw what now I trust is considered indispensable in every school—the blackboard." [22]

Mr. May in turn introduced the blackboard to the Common Schools of Massachusetts.

The blackboard was introduced to West Point Military Academy in

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[20] *Connecticut Common School Journal*, Feb. 1841, pp. 99–100.
[21] Johnson, *op. cit.*, p. 107.
[22] *American Journal of Education*, Vol. 16 (1866), pp. 140–141.

1817 by Claude Crozet, who had been an ex-officer under Napoleon, then appointed to the Academy as professor of engineering. When he arrived at the school, he found to his amazement that there were no textbooks in English. Thus he was faced with the problem of teaching a new science without a textbook, and he himself unfamiliar with the English language. Crozet solved the problem with the aid of a carpenter and painter who turned out the first blackboard to be used in that part of the country.[23]

In the 1820's a knowledge, if not the use, of the blackboard seems to have disseminated to other schools. In 1820 Joseph Felt, in his *Annals of Salem* (Vol. 1, p. 469) said: "Blackboards were used in our Common Schools for arithmetical calculations." An 1823 *Report of the School Committee* for Boston said: "They [arithmetic exercises] are afterwards drawn by the pupil on the blackboard."[24] A blackboard was introduced into Bowdoin College in 1824 by a Professor Smyth. "That novelty, let me say, made a sensation. . . . The blackboard caused an important change in the manner of teaching generally."[25]

In the 1830's educators stopped regarding the blackboard as a curious innovation and began to look upon it as essential to teaching. A lecturer in 1830 listed it as one of four essential apparatuses every school should have.

> One or more of these should be found in every school . . . This piece of school-furniture is almost invaluable. In some schools it has been deemed so important as to form part of the WALL, all around the room.[26]

The *Connecticut Common School Journal* of February 15, 1839, advised its schools: "In all the operations performed by the pupils . . . blackboards should be used for demonstrations and illustrations."[27] In the same journal,[28] a letter from a teacher ventured that "the most useful piece of school apparatus, may be simply a black board painted or stained black, attached to the wall or to a movable stand. . . . It is employed in teaching scholars of every stage of advancement."

By the 1840's the blackboard was firmly entrenched in the school systems. Texts for teachers on the use of the blackboard began to be written.

A few quotes from one of these[29] shows us, possibly with some ex-

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[23] *Loc. cit.*, Vol. 13 (1863), pp. 31–38.
[24] Fletcher B. Dressler, "Blackboards", *Cyclopedia of Education*, Vol. 1, p. 391.
[25] *Ibid.*
[26] Adams, *op. cit.*, pp. 345–346. (Emphasis is author's own.)
[27] *Connecticut Common School Journal*, p. 92.
[28] *Ibid.*, Oct. 1839, pp. 48–49.
[29] Josiah F. Bumstead, *The Blackboard in the Primary Schools*, Boston, Perkins & Marvin, 1841, pp. VII & VIII, respectively. (Emphasis is the author's.)

aggeration, that teachers were convinced that the blackboard was here to stay.

> , I should feel in the school-room, without the blackboard, as though the LAST PLANK had been taken from under me!

And again:

> The inventor or introducer of the blackboard system deserves to be ranked among the best contributors to learning and science, if not among the greatest benefactors of mankind.

In 1842, the *Connecticut Common School Journal* dedicated five entire issues including illustrations to "Slate and Black Board Exercises for Common Schools."

Technological State of Blackboards, 1800–1850

Most all blackboards were constructed in a similar manner until about 1850. The hyloplate and slate blackboard was a product of the last half of the 19th century. These were made either commercially or by the local carpenter since little machinery was involved. The blackboards were usually made of wood painted or stained black and were either attached to movable frames or hung on walls. Local teachers often made their own blackboards, so urged by School Journals:

> Now the word BLACK BOARD need not awaken in our mindes the thought of anything difficult, rare, or costly. Why it is simply a black BOARD. Is there any difficulty in painting a piece of board black?[30]

The writer went on to describe the process: plane the board until it is smooth and soft; then apply black paint or stain. He advised that the whole end of the school room could be painted black. Plaster mixtures colored with a dark black or green dye were also used.

Slates

The origin of the slate reaches far back into antiquity. Its predecessors were the wax tablets used by the Greeks and Romans and the black wax tablet used by the Hindus around 1000 A.D. The modern slate seems to have been in common use in Europe by the 1400's. Chaucer makes the first allusion to it in English in his *Astrolabe* II (p. 44), "enter hit in-to thy slate."[31]

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[30] *Connecticut Common School Journal*, Feb. 1842, p. 50. (Emphasis is the author's.)
[31] Louis C. Karpinski, "Slate," *Cyclopedia of Education*, Vol. V, p. 341.

Slates were slowly introduced into American schools. Although there are some allusions to them in the colonial period,[32] it was not until the 1800's that they were commonly used. In William B. Fowle's report to the trustees of the Boston Monitorial School in 1825, he says: "Every child in school is furnished with a slate and pencil, which are considered a part of the furniture of the school."

An article in the *Connecticut Common School Journal* of 1839 on "The Use of Slates" advises, "We can hardly recommend any experiments or methods more likely to succeed, than slate exercises."[33] By the 1840's, slates were as commonly used in schools as the blackboard. Strangely enough, there appears to be no connection between the spread of the slate and the blackboard.

Globes and Maps

Globes

The use of globes in schools was nothing new; some schools in colonial days possessed them. But, for the first time, they began to be regarded as essential items in the well-equipped school. Adams listed them as the second of four essential apparatus for the classroom in 1830:

> 2., Maps and Globes,—and in general, any other apparatus, provided it be simple and cheap, which helps to explain the phenomena of the earth."[34]

The same writer gives an enlightening description of the plight of the student in those days who tried to grasp the conception of a round earth without the assistance of a globe. He recalls that as a boy without this visual aid, he imagined the earth as "a hollow ball—half filled with earth, upon the level surface of which, he himself was standing, while the shell around him formed the sky!" But the writer went on to explain that he thought this to be relatively sophisticated as he felt most children understood the globe to be a circular plane![35]

Other educators hailed the globe as an indispensable teaching implement. A writer in 1841 opinioned that the terrestrial and celestial globes "are two articles of school apparatus, which nothing of the kind can supersede."[36] Every company that handled any kind of school apparatus always included globes, regardless of the size of his stock.

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[32] A letter from a New England schoolboy to his father in 1752 asks him to send, among other things, his "slate and som pensals."

[33] *Connecticut Common School Journal*, p. 78.

[34] Adams, *op. cit.*, p. 345.

[35] *Ibid.*

[36] A. Fleming, "On the Use of the Globes in Teaching Geography and Astronomy," *American Institute of Instruction* (Aug. 1841), Lecture VII, p. 164.

While awareness of the existence of globes was commonplace, the use of them was rare. Many of the schools were forced to report, as did one in Killingly, Connecticut: "We have no globes . . . of any kind." [37] Many educators saw this as unmerited neglect; for example, the writer mentioned in the paragraph above:

> And yet, so far as the knowledge and information of the speaker extend, these useful implements of learning are not to be found in many schools claiming to be well furnished with the means of instruction, and in many others, where they are found, are but little used, and that in a very superficial manner.[38]

There seems to have been two basic reasons for the neglect in the use of the globe: the relative high expense of the article; and the shortage of teachers trained to use them and lack of suitable textbooks to instruct untrained teachers in their use.

The first reason was by far the larger one. This gave rise to a "do-it-yourself" movement in which educators admonished teachers with the idea that illustrating the earth as a sphere was the only important thing and the purchase of an expensive school apparatus was not essential for this. The problem was summed up by one lecturer in this way:

> If unprovided with an artificial globe, he [the teacher] could not think even to buy an orange, and draw upon it with his pen an outline of the continents—much less, besides this; to take off the rind, and illustrate the projection of maps.[39]

Another writer told how he solved the problem in an inexpensive way:

> I advise you to have a globe. [Then he says sarcastically.] You cannot expect to obtain one from your school committee, but you can have a large wooden ball made, upon which you can yourself paste white paper, and draw anything you wish.

A still cheaper method came from Dwight's *School-Masters Friend:*

> You have seen pumpkin lanterns—yes, and you have made them too. Well let nothing prevent you from having a globe of some kind or other in the school.

He then proceeds to tell the teacher how to hollow out the pumpkin and make a globe.

Maps

In the more progressive schools, maps were extensively used as this remark by a Massachusetts' educator in 1841 shows: "We have . . .

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[37] Report of school visitors in *Connecticut Common School Journal* (1841), p. 197.
[38] Fleming, *op. cit.*, p. 164.
[39] Adams, *op. cit.*, p. 345.

maps, charts, and atlases greatly multiplied and introduced into all our schools."[40]

In the outlying district schools, however, the use of maps was probably even more rare than the use of globes. Expense was one reason. Moreover, the technology of mapmaking was still relatively crude, and the teacher by free hand could sketch a map that would serve the purpose as well as the inferior wood-cut or copper-cut maps. Thus many of the maps in the schools were drawn by teachers. The following excerpt from an 1838 journal describes the process.

> Those who have used outline maps in the study of geography, can need no recommendation of them. . . . Outline maps may be readily made and at a very small expense, by tracing the boundaries, rivers, lakes, mountains, etc., on one or more square yards of coarse white muslin, omitting the names. A camel's hair pencil may be used, with a mixture of lamp black, Gum Arabic, and water. The gum will prevent the fluid from spreading, even on unsized paper.[41]

The Abacus and the Numeral Frame

This apparatus, known by many names, came into general use during this period to offer a new dimension in math instruction. In 1830, Adams described it and listed it as one of the four essential apparatuses for the classroom of his day.

> The Abacus—this consists of a square frame, divided by ten strong wires, each of which passes through ten painted wooden balls, easily movable from one end to the other. This instrument is highly useful in illustrating the various combinations of numbers.[42]

Sometimes the apparatus was advertised as a numeral frame; at other times as a counter. An 1866 edition of an educational journal called it the Arithmetican.[43]

An idea of the simplicity of the item can be gotten from this article from an 1842 journal telling the teacher how to make his own numeral frame.

> For our purposes, an old slate frame will answer very well. The vertical sides should be pierced for 11 wires, 10 of which should be at equal distance, the eleventh further apart—say double the distance. On each wire should be placed 10 beads, half of one color and half of another—say blue and yellow—arranged as follows: 3 yellow, 2 blue, 2 yellow, 3 blue. Thus we shall have 100 beads, on 10 wire.[44]

In this way the child could cipher any number under 1,000.

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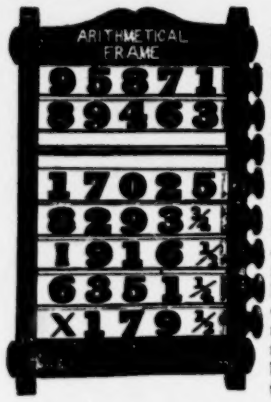
[40] Fleming, *op. cit.*, p. 164.
[41] *Connecticut Common School Journal*, Dec. 1838, p. 38.
[42] Adams, *op. cit.*, p. 346.
[43] *American Journal of Education*, Vol. XVI (1866), p. 577.
[44] *Connecticut Common School Journal* (Feb. 1842), p. 49.

[From the National Record of Education.]

IMPROVEMENTS.

The most practical teachers soonest see that pupils, who have been through the arithmetic quite understandingly, will often fail to perform *correctly* examples of only moderate length in the fundamental rules. Business men find that in almost every case, young men, fresh from school, cannot be depended on to add columns of figures correctly and rapidly. The fact is, that the usual school arithmetics contain examples sufficient to *illustrate* the rules, but far too few for *proper drill*, or practice. The *science* is taught, but pupils do not like to review the old pages, and teachers have not time to write new examples on the blackboard; hence pupils fail to acquire, at school, the *practical art* of combining numbers rapidly. Practice in the counting-room may remedy the defect, but only at the cost of expensive mistakes and much valuable time. Therefore, progressive educators will be pleased to find an apparatus which provides, at a moment's notice, an exhaustless store of examples in all the fundamental rules, and which, doubtless, is the most useful and practical article for common schools that has been invented within ten years, viz.:

THE PATENT ARITHMETICAL FRAME, imperfectly represented in the cut below.



It consists of *eighteen* slats, which revolve, having on each side *eight* figures, large enough to be read at a distance of forty feet, and giving over half a million examples in Addition, Subtraction, Multiplication, Division, Decimals, Federal Money and Reduction, without the necessity of the teacher's writing a figure on the blackboard. School officers by putting it into their schools, say to teachers, "We furnish you the means with which to teach our children *practically* for business," and this is just what intelligent teachers desire to do. If any hesitate because of expense, let such consider how little it costs for each of the many hundreds taught from it; for it is not worn out by handling, as books are, but is as good for future classes as for the present. It costs, with a key, $4.50

Several teachers who have used this apparatus, have expressed themselves as follows: "We are using it with great satisfaction;" "I can do the work of two men with it;" "In fact I could not get along without it," &c. We commend it with entire confidence, and add, on the following page, the more complete description and methods of using given by the manufacturers.

This Frame is equivalent to a movable blackboard, having examples always set, but changeable in an instant, when desired.

With young pupils the teacher may divide the 18 slats of the frame into 6 examples in Addition, or as many in Subtraction. As soon as these are performed, by turning one slat in each as many different ones are shown; after which, by revolving the other slat in each, the same number of new examples are again given; and an equal number more may be presented by turning the former slats to their original positions. *Thousands* of other examples, either long or short, may be given in Addition and Subtraction, as shown in the key.

For Multiplication each slat is a multiplicand, and any desired multiplier *for each* may be named by the teacher—as 3, or 25, or 408, etc. This gives in a breath 18 examples having the same multiplier—enough for a day's lesson. As pupils become more proficient, larger multipliers are named, to any desired extent.

In Division each slat is a dividend, and proper divisors are given by the teacher. It is evident there is *no limit* to the number and variety of examples that may thus be given.

The Key contains very many suitable examples, *with answers* in all the various rules; but teachers can give thousands of others, and it will be practically a safe rule to consider any answer correct in which half or a third of the class agree.

In well graded Primary Schools there will be *little need of arithmetics* at first, for sufficient examples for the day can be given by one arrangement of the frame.

For older Pupils the frame will furnish, by each different arrangement, 18 examples (either simple or difficult as the teacher may choose), which may be performed as extra work by the active pupils, who always complete the class lesson in the book and have idle time. For such overwork merit-marks may be given, according to the number of examples performed.

The Combinations of Addition, Subtraction, Multiplication, and Division are excellent for this purpose, and also for review lessons, as the various answers will show in what rules the pupil is most liable to make errors.

In Reduction each slat represents so many of the lowest denomination in any table, as ounces, or gills, etc., which the pupil must reduce to the highest, and prove his work by reducing this answer back to the lowest denomination.

Federal Money and Decimals are amply provided for in the key, and more examples may be given as readily as in whole numbers.

A very useful Exercise is, to set the frame and have all the pupils in a class commence at the same instant to work the example, each striving to be the first to have it *correctly* done. The older pupils in grammar and high schools will be interested and greatly profited by frequent trials of this kind.

Schools of every grade will find the frame well adapted to their wants. It will be used more hours in a day, and more days in every week, than any globe or set of maps costing five times as much. It will soon save its cost in the *time* of the teacher; it will save its cost in *crayons*; it will soon save its cost in books. Hence it is presented to school officers as the most *useful*, the most *economical*, and the most truly *labor-saving* piece of school apparatus ever invented.

For fuller details send 25 cents for the Key to

F. C. BROWNELL, Pres't, or N. C. BOARDMAN, Sec'y, } 21 John Street, New York.

Arithmetical Frame Teaching Device from American School Apparatus Co. Catalogue New York (1867) p. 12.

The Textbook Movement

Webster and McGuffey

The Revolutionary War interrupted trade with Great Britain and made school books extremely scarce. One young schoolmaster of the times, in Orange County, New York, decided a home source of textbooks was needed. In 1783, Noah Webster published a spelling book which evolved into the famous *Webster's Blue Back* that set the pace for American texts for the next quarter century. In 1785, only two years after its publication, it was selling at the rate of 500 copies a week. By 1818, 5,000,000 copies had been sold and for 40 years after that it was selling at the rate of 1,000,000 copies a year.[45]

Technologically, *Webster's Blue Back* represented no new improvements. The type was movable (set by hand) and not always too clear. The work was bound by hand and until 1829 consisted of a back of leather and sides of thin oaken boards pasted over with a dull blue paper. It was this bluish paper that gave rise to the nickname *Blue Back.*

The book contained crude wood-cut illustrations. One edition was embellished with a dreadful woodcut of Noah Webster which made him look like a porcupine and was described by critics of the day as "being so ugly it scares the children from their lessons."[46] Textual material was about on the same level and mainly aimed at moralizing.

Webster's Blue Back gave rise to a whole hoard of imitations. The first text to seriously rival it was the famous McGuffey *Reader.* Originally, William Holmes McGuffey had written a beginning reader for Truman & Smith of Cincinnati, in 1830. In 1841, he and his brother, Alexander, had completed a series through the *Fifth Reader.* These readers came to be the literary bible of the Middle West, the South, and parts of the East up to New England. The *Readers* were continuously revised, and by 1920 estimated sales were placed at 122,000,000. It is still on the market.

McGuffey's *Readers* at first had all the crudeness of the earlier texts. However, as it lasted the whole century each new edition benefited from technological changes. For example, the first editions of McGuffey's *Reader* in 1836 and 1837 were printed from movable type. But by 1800, stereotyping had been invented by Stanhope and by 1840 had come into general use. Editions of the *Readers* after 1840 were printed from plates. This possibily accounts for the greater circulation of McGuffey's *Reader*, which was much larger than any of its

[45] Johnson, *op. cit.*, pp. 168–169.
[46] *Ibid.*

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earlier competitors. In the 1860's, the book adopted the new electrotyping process of printing.

Other Milestones in Texts

While Webster and McGuffey dominated the textbook movement of this period, several other textbooks made new technological contributions. Peter Parley's *Method of Telling About Geography*, published in 1829, had the important innovation of flexible pasteboard sides. His *National Geography*, published in 1845, was the earliest to take the large, flat shape. This enabled the inclusion of good-sized maps and eliminated the necessity for a separate atlas.

Also, a certain Arnold Guyot, a Swiss immigrant, caused in 1848, a minor revolution in the geography text field if not in map making in general. In 1862, he wrote his first geography for Charles Scribner & Sons which utilized illustrations and maps more than had any book published before. It appears he also introduced the technique of map coloring to indicate elevation (green for sea level, etc.). The political divisions of the countries were traced in red lines. These innovations were destined to win much praise from foreign educators at international exhibitions during the next half century.[47]

Photographic Illustrations in Texts

In the mid-1800's, the new art of photography was reaching an advanced state of development, and educators and technicians began to use photographs to illustrate texts. Some tried filtering sunlight through the negative to yield etchings on copper or steel and then printing from the plate in the ordinary way. Sir David Brewster of Scotland suggested that the new process of galvanography could give the photographs the permanence of engravings and then could be used in the illustration of educational works.[48] Others sought to attach the photographs directly.

In 1856, the first serious attempt to illustrate a text with the extensive use of photography was made by John W. Draper in his *Human Physiology, Statical and Dynamical.* The illustrations were printed from copper plates, which the artist had prepared from photographs.

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[47] *Manual of Geographical Teaching, A Discussion of the Principles Underlying Guyot's Methods*, New York, Scribner, Armstrong & Co. (1870), pp. 14–16.

[48] Sir David Brewster, *The Stereoscope, Its History, Theory, and Construction With Its Application to the Fine and Useful Arts and to Education*, London; John Murray (1856), p. 196.

In 1856, *Harper's Magazine* listed several advantages of this new technique in a review of Draper's book:

1. Only a photograph produced the necessary sharpness of a microscoped object required by an artist to copy microscoped objects accurately for a copper cut.
2. The European anatomists for some time had possessed large, excellent charts of medical science. But because of their complexity, it was impossible to copy them on a reduced scale for textbook illustrations. But with the aid of photographic-reduction, the printer could cheaply make copper cuts so that the student could have the advantages of these masterpieces of science.
3. Photography could reproduce with permanent accuracy scientific objects which "very soon spoil and even become disgusting." To illustrate this, the magazine showed a copper cut reproduction of the photo of the digestive tract of a chicken.[49]

Abundance of Textbooks

After this short survey of the textbook movement during this period, it should be obvious that significant progress had been made in this field. Superior technological changes had been introduced, and the textbook industry had become a mass production operation.

But mass production technique brought new problems to the schools and added to the number of educational critics. As early as 1839, an educational journal recognized that "no complaint is more common than that which is made against the variety of school books." [50]

A critic writing in 1852 unleashed his wrath about the over-abundance of texts flooding the schools thusly:

> The houses of many of us are overflowing with the results of this misdirected industry and mercantile enterprise, so that not a few of us are obliged to refuse admission to any further specimens of school literature. . . . There can be no justification for the flood of dreary looking productions that are conveyed in the carpet-bags of courteous agents from town to town.[51]

However, his solution to what was actually a worthwhile revolution in education was lacking in constructive realism.

> The temptation to manufacture schoolbooks is just now very strong, but it must be manfully encountered, like any other temptation.[52]

This is reminiscent of some modern-day educators who vigorously oppose new technological innovations in education without offering any realistic alternative solution to the problem involved.

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[49] "On the Application of Photography to Printing," *Harper's Magazine* (New York), Vol. LXXVI (Sept. 1856), pp. 433–441.

[50] *Connecticut Common School Journal* (Jan. 1839), p. 50.

[51] "School and College Text-Books," *The Christian Examiner*, Boston, Vol. LIII, Nov. 1852, p. 426.

[52] *Ibid.*, p. 426.

Part III

CIVIL WAR TO 1900

BEGINNING IN THE 1860's, technological developments—spawned in war and nurtured in peacetime—resulted in improvements in communication, power, and transportation. A new and powerful nation based primarily and necessarily on industrialization was emerging. However, these technological advances actually had little impact on education at this time. Few new instructional devices were introduced. It was mainly a period of polishing and streamlining what already existed, though mass production methods did lower prices and extend the benefits of existing apparatuses to more areas.

Attitude Toward Educational Technology

A significant evolution in attitude occurred during this period. The new educational apparatuses introduced before the 1860's, once regarded as novelties, now were regarded as necessary educational implements. An education journal of 1870 [1] sums up the attitude that prevailed.

> It is an important part of the duty of those who have charge of our schools to provide them with suitable apparatus. Houses and teachers are indispensable; but good apparatus is scarcely less so. Let our teachers have proper implements to work with—then we may reasonably expect work to be done.

This attitude was so widely accepted that the states passed legal statutes to enforce it. Section 56 of the Virginia School Law of 1882 read: "No school district shall receive any part of the funds unless it has made provisions for school-houses, furniture, apparatus, textbooks for indigent children and all other means and appliances needed." [2]

The 1887 School Laws of Oregon [3] stated:

> **Apparatus**
>
> 10. Globes, charts, numeral frames, outline maps, paper, text-books, cube and square root blocks are necessary appliances for the efficient management of every school.

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[1] *The American Education Monthly* (New York), Vol. VII (1870), p. 420.
[2] *The Education Journal of Virginia* (Richmond, Va.), Vol. XIII (June 1882), p. 240.
[3] U.S. Bureau of Education, *Report of the Commissioner of Education for 1886*, p. 206.

Furniture

11. Among the indispensable articles of furniture are a few chairs, a teacher's table, a black-board and crayons, etc.

Dissemination of Knowledge About Educational Technology

When something becomes common knowledge, it ceases to be a novelty. This accounts in part for the change in attitude in educational technology mentioned above. There were several factors working during this period which brought the latest information on school equipment to even the most rural schools.

After 1860, there was a veritable flood of new educational publications in Journals, Reviews, and Weeklies. The States began to publish their own educational journals to keep their teachers informed. The larger cities might publish four or five such journals, hoping for nation-wide consumption. This wave of educational "intelligence," as the exchange of ideas on education was called in these journals, is especially interesting from the viewpoint of this study. Articles were carried regularly on the latest ideas in school equipment, and the publications were usually crammed full of advertisements from the school furniture and apparatus companies. Their enticing illustrations and glowing sales claims probably went far in persuading teachers that the newest in educational apparatus was a basic necessity.

Also during this period, the International Exhibitions did much to disseminate knowledge on more than just a local basis. It became the standard practice after the World's Fair in London in 1851, to include educational exhibits representing the latest in educational technology and methods from the different nations. The most important exhibitions were, in Paris, 1855; London, 1862; Paris, 1867; Vienna, 1873; Philadelphia, 1876, and Paris, 1878. Also containing important educational exhibits were, the Health Exhibition, London, 1884, and the World's Industrial Centennial and Cotton Exposition, New Orleans, 1885.

The impact of these educational exhibitions was important. For example, at the Centennial Exhibition (Philadelphia, 1876) the exhibits from the technical schools of Moscow and Petersburg so impressed President Runkle of M.I.T., that he obtained the exhibits and used them as the basis for the first laboratory system in U.S. Schools.[4] In other cases, the exhibitions were displayed at libraries and museums

[4] Richard Waterman, Jr., "Educational Exhibits at the Columbian Exposition," *Educational Review* (New York), Vol. VII (1894), p. 122.

throughout the world. The U.S. Bureau of Education formed an exhibit from the objects left by the Centennial Exhibition.

Opposition to Advancing Educational Technology

As can be expected, this period had its feet-draggers. Many felt the new educational apparatuses to be so complicated as to be completely beyond their ability. Even the simple innovation of object teaching as a visual aid was criticized on this ground:

> A practical objection will occur to everyone—the disqualification of the majority of teachers to use the system. It is above them. It is too high a kind of instruction. It requires more available knowledge, tact, and experience than most teachers can command. We are not all Arnolds or Manns.[5]

Others had nightmares of the schools being converted into educational factories, where the teacher would be little more than a mechanic manipulating educational apparatuses. A speaker before the New York State Teachers Association voiced this opinion in 1870:[6]

> The old-time schoolhouse . . . is giving place to finer buildings . . . we have improved desks and settees, improved maps and charts, improved slates and globes, and improved textbooks . . . . We are certainly far in advance of anything in our past, and are said to be far in advance of other nations.
>
> But just here, it seems to me, in the line of our greatest excellence, lies our greatest defect and our greatest danger. In looking so closely after the mechanism of education, we have lost something of the life and spirit of our teaching. Our methods are . . . mechanical and superficial . . . . So long as people like showy mechanism in our schools, so long they will have it.

This idea of showmanship instead of utilitarian value in the educational apparatus of the day had some ground. As was noticed earlier, few really new instructional apparatuses were introduced; most of the manufacturing companies simply refined what had been used a few decades previously.[7] Thus when a certain point of refinement was reached, a period of stagnation followed. Many educators felt that the apparatuses were used more as prestige or status symbols by the schools than as implements for teaching. One writer voiced this opinion:

> Instructors use [apparatuses] . . . as a means of drawing patronage, by publishing in a marked manner, the cost of their apparatus. If their valuations are true (and they are often to be doubted), they usually in-

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[5] *The American Education Monthly*, Vol. III (Jan. 1866), p. 22.
[6] *The American Education Monthly*, Vol. X (Apr. 1873), p. 151.
[7] *The Report of the U.S. Commissioner of Education for 1872*, published, for the first time, statistics on patents in school furniture, apparatus, etc. It listed 134 patents and almost every one of them was simply an improvement on some apparatus already in use, such as the blackboard, etc.

> clude the cost of every article purchased since the school was founded, whether it now has any value or utility. Examine the apparatus of most of our academies, and you will not find one in five where one-half of the instruments are in working order.[8]

The following is a brief description of some of the technological advances made in education during this period and their impact, if any, on the education system as a whole.

School Architecture

After the Civil War, a wave of prosperity swept over the North. This gave rise to a new and ornate type of architecture for school buildings. The main architectural innovation during the decade after the Civil War was the introduction of more space and comfort and a trend away from the austere if not severe appearance of the past.

At the World Exhibition in Vienna in 1873, the United States displayed a full-sized schoolhouse. Foreigners noted that its 11,583 cubical feet of internal space (for 48 children or 241.31 cubic feet per child) made it far more spacious than any other classrooms exhibited.[9] The Austrian report gave a good description of the inside:

> The house had separate entrances, on opposite sides . . . with small halls for taking off the walking garments. . . . The uncommonly high *and airy* room received its light through six narrow, high windows. . . . The blinds, which could be moved and rolled up in any direction, were most efficient.[10]

The British remarked on the "elegance and comfort" of American school architecture. Their report said, "Austerity and gloom are too often the leading features of our school system, and it would doubtless be a progressive step to borrow a little of the American amenity." [11]

In the 1880's, the so-called "Queen Anne" or hard-pine style came into vogue. Even more ornate, it equipped the school building with towers, spires, gothic windows and wooden scroll work. Badly proportioned and meaningless ornaments were attached outside. Inside, internal balconies, pillars, winding stairs and elaborate mural decorations made the schoolhouse one of the most imposing edifices of the community.[12]

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[8] *The American Education Monthly*, Vol. III (Apr. 1866), pp. 134–135.
[9] Great Britain Royal Commission, *Reports on the Vienna Universal Exhibition of 1873*, London, H. M. Stationery Office, 1874, Vol. III, p. 593.
[10] U.S. Commissioners, *Reports on the International Exhibitions Held at Vienna, 1873*, Washington, Government Printing Office, 1876, Vol. X (Foreign abstracts), p. 440.
[11] Great Britain, *op. cit.*, p. 593.
[12] May Ayres, "A Century of Progress in Schoolhouse Construction," *American School Board Journal*, Vol. 54 (1919), p. 25.

Toward the end of the century, it became evident that these schools were too elaborate and wasteful in construction. In an effort to reverse the trend, an era of standardization was begun which almost resulted in complete stagnation. Sloping roofs were discarded, blank end walls became mandatory, and auditoriums came down from the attic to the first floor. This practice of piling the building high in the air for four or five stories gave rise to the nickname of "a packing box" school.[13]

World War I, with its wide-spread use of steel construction, introduced a new school design. One-story school buildings came back into vogue with their pitched roofs and there was more of an attempt to integrate the building into its surroundings.

School Furniture

In this field, steady improvement was being made. The long bench-like desks and seats of the pre-Civil War period had given way to separate or individual desks for the students. The desks and seats displayed at the Vienna Exhibition in 1873 won acclaim from other nations. The Austrian report furnished an excellent description of the furniture displayed by the United States:

> The American seat was noticeable. This seat was placed on an iron base, on which it could be folded; it was made of beautiful broad, polished laths, which, in order to prevent overheating, did not fit closely together. The table top is movable forward, and covers a small recess for books. The arrangement was of a compact form, having a seat for one row of boys backed by a desk for the next row, and thus the support of the desk in the rear served as a back for the seat in front. These backs were rounded, slanted backward and comfortable. They could be folded up entirely.[14]

This double or combination desk with cast iron frame and wooden top became well standardized in America over the next few years. By 1891, practically all the desks were of this type. Then in 1906 the first pedestal-supported combination desk was produced. Designed by a St. Louis architect, it offered an improvement in height adjustment and greater ease in sweeping. Its big disadvantage was its immobility.

Following the pedestal desk, ordinary wood chairs with tablet arms were used. The first really movable seating was developed by Moulthrop, a New York school principal. It was a wooden chair-desk with a book drawer under the seat and an adjustable top. Moulthrop then went on to develop the "Universal" desk, having seat and desk

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[13] Walter H. Kilham, "Aesthetics in Schoolhouse Design," *The American Journal of Education*, Vol. 72 (1926), p. 39.

[14] U.S. Commissioners to Vienna, *op. cit.*, Foreign abstracts, p. 444.

Normal or Collegiate Desk

SEMI SPINDLE AND RIM CHAIR.

This desk is specially designed for use in the higher schools and colleges. It is a model of beauty and convenience. The castings are unsurpassed for perfection in outline, carving, etc., and are provided with the adjustable foot rest. The chair, which has a bent oak rim, is very strong and is finished either light or in imitation of walnut. An ordinary movable chair can be used. Each desk is furnished with ink-well and lid support.

Andrews' Patent Desk Lid Support.

IN USE UPON ALL OUR LID DESKS, INCLUDING TEACHERS' DESKS.

This Lid Support is a new invention, and secures a most desirable result not hitherto accomplished. It is made of steel, and is self-springing, self-acting, and self-sustaining. The desk-lid cannot be dropped "down" or "over backwards," as the support holds it in *any position*, and is at the same time the strongest "check" against throwing the lid back too far. The motion of the lid works it without the hand

The "Triumph Study" Desk.

ONLY 10 INCHES FROM THE EYE TO THE BOOK.

Notice the natural, easy, and healthful position of the Scholar.

The "Triumph Study" Desk is constructed on the same method as the "Triumph" Desk and possesses all the advantages of the dovetail process, so fully described in the preceding pages. It is well proportioned, **handsome,** *very* **strong** and **durable.** Although it has not been in use as long as the "Triumph" it has already obtained a degree of popularity that ensures its success, and places it in the front rank of school desks. The cuts partially represent the advantages of this desk, which is made, either single or double, in all sizes.

"Triumph Study Desk" showing conventional combination desk of period from Baker, Pratt & Company, Cataloque, New York (1879) p. 21.

separately and adjustably supported from a movable frame. It has been continually changed and refined up to the present time.[15]

A revolution in the manufacturing process of school furniture was also occurring. Before 1900, most of the school desks and seats were manufactured locally or in nearby towns; no large, centralized factories existed. Then at the turn of the century, Thomas M. Boyd of the Sidney School Furniture Company conceived the idea of establishing a large public seating industry. It was an era of mergers, so during the next six years, Boyd consolidated some 25 school, church, and opera seating companies into the American Seating Company. Its larger manufacturing operations made better furniture available to the schools at inexpensive prices.[16]

But even though school furniture had made spectacular gains, there remained room for steady improvements since the turn of the century. John Dewey envisioned needed reform when he described the ordinary classroom in 1900:

> . . . with its rows of ugly desks placed in geometrical order, crowded together so that there shall be as little moving room as possible, desks almost all of the same size, with just enough space to hold books.[17]

Blackboards and Slates

Blackboards

The blackboard continued to be a popular and widely used instructional implement during this period. A school catalogue of 1881 described its importance in these terms:

> No one article of apparatus for the schoolroom is more indispensable than the blackboard. . . . It is the TABLET for recording mental processes of the pupil. . . . It is the MIRROR reflecting the workings, character and quality of the individual mind. It is the chief auxiliary of the teacher; the AID-DE-CAMP, the MONITOR, the GUIDE.[18]

There were some improvements introduced. Blackboards were now framed, put on rollers, or would even rotate within the frame. Some were made of heavy paper that could be rolled up after use. Companies still advertised blackboard preparations for the teacher with a do-it-yourself inclination. With a gallon of this preparation, a slate surface could be applied "to plaster, wood, paper, and in fact, any surface to which paint may be applied" by anyone "who can handle a paintbrush and read the English language."[19]

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[15] Henry Eastman Bennett, "Fifty Years of School Seating," *The American School Board Journal*, March 1940, p. 42.

[16] *Ibid.*

[17] John Dewey, *The School and Society*, Chicago, University of Chicago Press, 1900, p. 48.

[18] Andrews & Co., *Illustrated Catalogue of School Merchandise*, Chicago, 1881, p. 73. (Emphasis is the author's.)

[19] Boston School Furniture, *Illustrated Catalogue*, Boston, Solon Thornton, Printer, 1870, p. 44.

COLORED CRAYONS.

Nine Assorted Colors or Shades.

Per Gross, in Boxes **$1.50**

Common Chalk Crayons, by Gross or Case lots of 50 and 100 Gross each. Lowest price given according to quantity, on application.

THE CRAYON HOLDER. HALF SIZE.

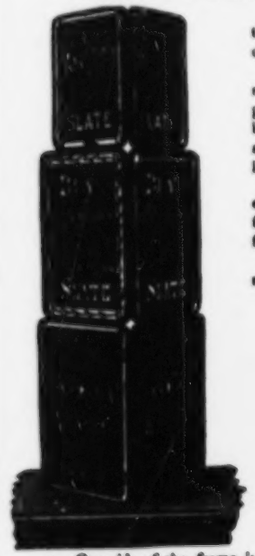
Where the common chalk crayon is used, a convenient and durable crayon holder is a necessity; but those who use the **Dustless Crayon** will need no contrivance of this kind to prevent soiling their hands while working at the blackboard. The crayon holder, illustrated above, is adapted to receive an entire crayon (which should be inserted small end *first*). It is light and pleasant to touch, and cannot soil the dress or fingers, while it is short enough to be held easily and naturally in the hand, as a crayon. Being made entirely of wood, it **will not scratch** the blackboard. In utilizing the small pieces of crayons which cannot be held in the fingers it will quickly save more than its cost. **Price, per doz. 75 cents.** Sample *mailed* for ten cents.

CRAYON COMPASSES.

Handsome, Nickel Plated, with steel point, and adjustable holder for crayons.
Length of legs about 18 inches.
These are the finest compasses that are made.

Price **$2.00**

Andrews' Noiseless School Slates.



1. The Frame is of hardwood thoroughly framed and glued at the corners.
2. Over the outer edges and corners (see cut) is firmly attached by a patent process, the corded duck webbing of bright color, very attractive and making this slate entirely noiseless.
3. This material is manufactured expressly for the purpose, and is five to ten times as durable as the flimsy felt goods found in the market.
4. The frame is handsomely ornamented or figured.

Single.

5. One side of the frame is marked off into inches, eighth and sixteenth inch measurements like a rule. The other side of frame has the measurements of the METRIC SYSTEM up to 20 Centimetres.
6. The frame is finely finished and varnished, which can be said of NO OTHER SLATE.
7. The Slate itself is of the best quality of stone to be found in this or any other country.

Prices of the New "A" Slates:

Size.	Per Dozen. Single.	Per Dozen. Double.	Doz. in Case. Single.	Doz. in Case. Double.	Per Case. Sin. or Dbl.
5x 7	$3 40	$4 80	18	9	$48 60
6x 9	3 00	6 00	12	6	36 00
7x11	3 60	7 20	10	5	36 00
8x12	4 80	9 60	8	4	38 40

Assorted Cases Containing

3 doz. [illegible]; 3 doz. [illegible]; 3 doz. [illegible]; 3 doz. 5x12, Single Slates, or
1 doz. [illegible]; 1½ doz. [illegible]; 1½ doz. [illegible]; ½ doz. 5x12, Double Slates, **$36 60**

We also furnish them in Assorted Cases, containing one-half single and one-half double slates.

Slates and Slate Accessories from Andrew's & Co.'s Illustrated Catalogue (1881) pp. 76-77.

However, these simple techniques were on their way out. The blackboard industry began to use complicated methods of pressing boards together (hyloplate) and slate application. Near the turn of the century, the natural slate, though expensive, began to replace the inferior wooden blackboards.

The blackboard has not disappeared from even the most modern of American schools today and probably never will. However, in the early 1920's, there began to be complaints by educators of blackboards wrapping around the whole schoolroom. Studies verified their suspicions that only a small fraction of the blackboard space was ever used. Thus, today the blackboard has given way to the bulletin board, picture space, project space and other mediums of visual instruction.

Slates

Slates continued their popularity during this period, especially in rural areas where other writing materials were not so easily and cheaply obtained. As late as 1881, the Andrews Co. *School Catalogue* devoted two whole pages to advertising school slates. Little technological progress had been made in their manufacture; they were simply slate stones encased in hardwood frames. However, because of their cheapness, they served a good purpose in their day. One could be bought for as little as 40¢, depending upon size, and a dozen or two could be purchased at a special price.

The main criticism against slates was that they were dirty, noisy, and hard on the students' eyes. These factors and the appearance of cheap, clean paper and lead pencils doomed the slate. By 1900, slates had disappeared from nearly all the schools except those in the most remote rural regions.

Paper, Pens, Pencils, and Ink

Paper

The impact of cheap writing paper on the schools certainly was considerable, though hard to measure. The growth of the paper industry alone indicated a rapidly expanding market. In 1860, there were 555 paper mills in the United States. By 1870, the number had jumped to 667, and by 1880, to 742 mills.[20] In the 1890's, there was a concentration of capital and consolidation of individual firms into large concerns. Though the number of mills decreased during this period, output increased significantly.

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[20] Hellmut Lehmann-Haupt, *The Book in America*, New York, R. R. Bowker Co., 1939, p. 140.

Technological advances in paper manufacturing during this era brought better quality at a cheaper price. By the 1880's, handmade paper was rapidly disappearing and by 1897, there was only one firm in the United States that still made paper by hand. A school catalogue of 1879 advertised ten pounds of writing paper as cheaply as $2.70.[21]

Pencils

Besides having a great impact on education, the pencil industry possesses a history deserving of more than passing interest. Begun in England, in 1564, and refined in France in the 1700's, it did not become a big industry until it settled in Nuremberg, Germany in 1761 under the tutelage of the Faber family. With remarkable foresight, they gained control of the Siberian graphite deposits (the only known ones in the world at the time) and established sawmills in the United States to work the soft Florida junipers for casings. In this way they fashioned a world monopoly of the pencil industry, even though importing all the raw materials.[22]

In 1861, Eberhard Faber introduced the pencil industry into America by starting a factory in New York. But it was not until World War I that the enterprise in the United States became a self-sufficient industry. This explains why most of the school catalogues, even after the turn of the century, advertised mostly imported German pencils.

Regardless of the monopoly, both lead and slate pencils were priced very reasonably. A box of 100 German slate pencils could be bought for as little as 25¢. Lead pencils were more expensive; an American Company (Dixon's American Graphite Pencils) advertised them at 50¢ per dozen.[23]

Fountain Pens

As has been noted, crude fountain pens (or steel pens as they were called) were in use before the Civil War. In fact, the first patent for a steel pen was granted in 1809 to a Baltimore shoemaker named Peregrin Williamson. But it was not until the 1880's that the fountain pen became a practical writing instrument, though even then, pens were not widely used.

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[21] Baker, Pratt & Co., *Illustrated Catalogue of School Merchandise*, New York, 1879, p. 92.
[22] Godbole, *Manufacture of Lead and Slate Pencils* (India?), 1953, pp. 1–10.
[23] Baker, Pratt & Co., *Catalogue*, 1879, p. 144.

School Rulers.

These Rules are twelve inches in length, of hardwood, varnished, accurately stamped on beveled side, in black. The wide rules are 1¼ inches wide and have inch and eighth inch measurements; also the **metric** measurement up to 20 centimetres.

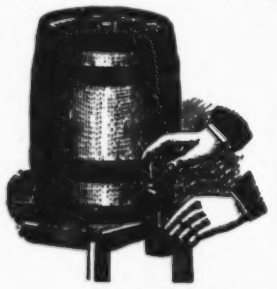
The cut is from a photograph.

Prices of School Rules, wide, inch and metric measure, per gross (in doz. boxes), $4.20, 12 in box. Per doz. 48 cents. Narrow Rules, ¼ inch wide with inch and eighth inch measurement, 24 in box, per doz. 36 cents. Per gross, $3.60.

School Inks---Black or Violet.

The best School Ink made. Will not corrode or mould; is not injured by freezing; changeless in color. Black ink flows jet black from the pen.

1 Gallon in jugs	$ 2.00
2 Gallons "	3.50
3 Gallons in kegs with faucet	5.00
5 Gallons " "	7.50
10 Gallons " "	13.50
20 Gallons " "	25.00
40 Gallons " "	45.00



Slate Pencils.

Union, 6¼-inch, paper, covered in Red, White and Blue, pointed, 100 in box, 70 cents.

German, 5¼-inch, pointed, 100 in box, 25 cents.

New Mottoes for the School-Room.

Mottoes which may be hung up in sight of the scholars, when appropriately selected, have a decidedly moral effect. They may be hung by a cord like a picture, after perforating the upper corners, or they may be tacked upon the wall. In some cases it may be well to exhibit but one, two, or three at a time, and to call attention to such as have special application to some particular delinquency on the part of an offending pupil. The moral precept or motto may then be the subject of a brief remark by the teacher, either in public or private. Or, the motto will serve as a constant monition, incentive, or encouragement to the whole school. The following have been selected with care. Set No. 1 for District schools, and No. 2 for Higher grade schools.

No. 1, printed on heavy, colored cardboard; size of cards, 7¼ inches by 14 inches; printed with showy black letters that can be seen across the school room. Per set, put up in packages, $1.00.

The mottoes are as follows, printed on twelve cards as numbered:

SET No. 1.

1. *Make a Good Rule and Keep it.*
2. *Know Thyself; Honor Thyself.*
3. *Do the Next Thing. I will Try.*
4. *Do not Swear. Guard the Tongue.*
5. *Be Faithful. Life is Short.*
6. *I am Late. Sloth Impoverishes.*
7. *I Am Early. Diligence Enriches.*
8. *Not Who I Am, but What I Am.*
9. *Be Kind and Be Polite.*
10. *Be Honest and Be Earnest.*
11. *Be Truthful. God Sees Me.*
12. *You Can if You Will. Labor Conquers.*

No. 2. For High Schools; large and showy; in colors and bronzed. Varnished so as to be easily washed off when soiled; suitable for framing. The finest set of mottoes for the price ever published. Size, 14 inches by 22 inches, on stout cardboard; Price $2.50. Sold separately for 25 cents each.

SET No. 2.

1. *Scorn to Do a Mean Act.*
2. *Do to Others as You Would Have Them Do to You.*
3. *Do What You Ought, Come What May.*
4. *You are Known by the Company You Keep.*
5. *Learning is Better than Riches.*
6. *A Fault is Made Worse by Trying to Conceal it.*
7. *Not Genius, but Industry Wins.*
8. *Little Strokes Fell Great Oaks.*
9. *Constant Occupation Prevents Temptation.*
10. *Nothing is Difficult to Him Who Wills.*
11. *Learn to be Systematic.*
12. *Unmerited Honors Never Wear Well.*

Advertisement of School Ink from Andrew's & Co.'s Illustrated Catalogue (1881) p. 82.

An 1879 catalogue advertised an "Automatic Fountain Pen" for 25¢ and listed among its virtues the fact that "after being filled with ink, [it] can be safely carried in the pocket." [24] But the same catalogue listed a box of 24 quill pens as costing only 30¢.

It has been estimated that even as late as 1912, only 5 percent of the population in the United States owned fountain pens. But it seems that in the 1920's the industry was stimulated by the spread of literacy and the World War (soldiers writing letters back home). The growth was so spectacular that in the 1930's, the United States took the lead in world pen manufacturing.[25]

Ink

The actual technology of ink manufacturing changed little during this era from that used centuries before. However, the appearance of specialized companies brought the price of commercial ink within the price range of every school. A dozen 4-ounce bottles of ink could be purchased for $1.10. A gallon of ink cost only $2. One company advertised kegs of ink ranging in capacity from 3 to 45 gallons for a little over $1 a gallon. These kegs were equipped with faucets whereby the teacher or student could draw the ink, one ink-well at a time.[26]

Globes, Maps, and Charts

Globes

The manufacturing of globes during this period offered no technological breakthrough. There were some minor improvements, but these usually served only to add more to the price of the globe than the improvement was worth. This was noticed by the French Committee who reported on the educational exhibit at the Vienna World's Fair in 1873. "The United States exhibited many globes. . . . Those which were exhibited were distinguished by nothing original. We sought in vain for globes with iron frameworks." [27]

Here are a few of the changes that did appear in United States globe making. A rather ingenious method of illustrating the global

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[24] *Ibid.*, p. 94.

[25] Daniel Parker, *The Pen Industry*, Cambridge, Massachusetts, Bellman Publishing Co., 1955, p. 6.

[26] Andrews & Co., *School Catalogue*, 1881, p. 82.

[27] U.S. Commissioners, *Reports on the International Exhibitions Held at Vienna, 1873* (Foreign abstracts section), p. 357.

Andrews School Furnishing Company, New York.

The Yale Three-Inch Slated Globe.

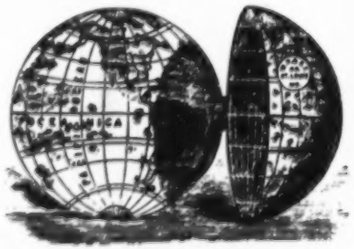
WITH GRADUATED RING.

This little Globe is used in large numbers by the classes of Professor E. L. Richards, of Yale University. It has proved so excellent an adjuvant in all the common work of Spherical Trigonometry, as well as in the solution of certain practical astronomical problems, that he has written a Manual for its use.

This Manual is written in the spirit of "the new education." It is suggestive in its mode and cannot fail to encourage the timid thinker, while it inspires the holder one to push out beyond what is taught into original work.

Price of the Globe, with the Richards Manual, $2.00.

Hemisphere Globes.



The invention of a practical teacher for making young pupils understand the identity of the common *flat* map with the *convex* map of the globe surface.

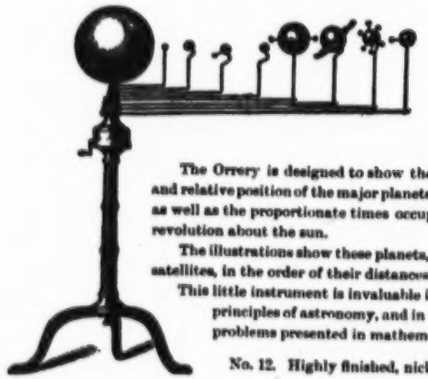
No. 66. 6-inch..... $5.00
No. 75. 5-inch..... 3.50

Slated Globes.

No. 23. 12-inch.... $3.00
No. 41. 8-inch..... 1.00

Andrews School Furnishing Company, New York.

Andrews Improved Orrery.

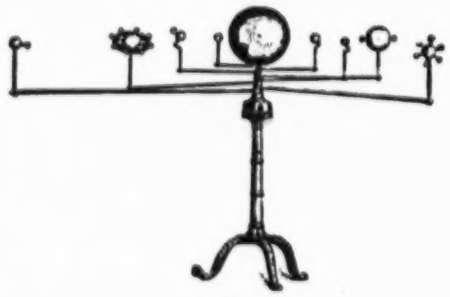


The Orrery is designed to show the proportionate size and relative position of the major planets of the solar system, as well as the proportionate times occupied in their annual revolution about the sun.

The illustrations show these planets, each with its proper satellites, in the order of their distances from the sun.

This little instrument is invaluable in teaching the first principles of astronomy, and in making plain many problems presented in mathematical geography.

No. 12. Highly finished, nickel-plated, $20.00



Globes and Orrerys from Andrews School Furnishing Co. Illustrated Catalogue (New York) 1895, pp. 68-69.

projection of the world along with the flat hemispheric projection was tried in the so-called "Hemisphere Globe." It was simply a regular globe hinged at some point where it would open into two halves. Thus on the face of each half, there naturally appeared a projection of that hemisphere.

The "Slated Globe" was a round, black sphere with nothing on it. The idea, in effect, was to have a round blackboard of the world upon which the student could chalk in the continents, oceans, etc. Then there was the "Relief Globe," which was simply a scale model of the earth. The company advertising it described it as showing "the solid earth as it would appear if all its water were removed, thus revealing the beds of the oceans and the forms of the continents below, as well as at sea level." [28] Made of copper, it sold for a whopping $100.

Tellurians and orreries for showing the planetary system, the earth's relation to the sun, etc., were popular for a time. Some of these so-called scale models of the solar system were so elaborate that the moons around the various planets were depicted by small balls fastened to the planet by hair-like rods. Actually these apparatuses probably misled more scholars than they instructed, or so was the charge made by many educators of the day. They were not scale models at all and were a rather expensive way of showing the difference between night and day.

Maps

American maps did offer something new and exciting in the way of educational technology during this period. The United States exhibition of maps at the Vienna Worlds Fair in 1873 brought praise from foreign educators. Much of the progress in school maps was due to the innovations introduced by Guyot, who was mentioned earlier in this study. The British educators made the following comment:

> Mr. Guyot again outstripped his competitors. His wall maps are skillfully executed, and the physical features of the countries represented are well and effectively brought out.[29]

The maps of the period were not only better but also cheaper. In 1872, Rand McNally & Co. introduced a new relief line engraving process for making maps. This revolutionary method cut the cost of production several times. Under the old system, maps

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[28] Andrews School Furnishing Co., *Illustrated Catalogue*, New York, 1895, p. 55.
[29] Great Britain Royal Commission, *Reports on the Vienna Universal Exhibition of 1873*, London, 1874, p. 357.

ANDREWS' GEARED TELLURIAN.

No. 6 A. Plated, with compass, best, new cog-wh[eel] pensing with cord, complete, . . . [movement, dis-] $ 15.00

No. 6. Next best finish, with day circle and compas[s, brass, (see cut). 10.00]

The TELLURIAN is an instrument design[ed to illustrate all the] phenomena resulting from the relations of S[un, Earth and Moon to] each other, and show the causes of the followi[ng:]

1. Succession of Day and Night and their differ[ence in length.]
2. Changes of the Seasons: Vernal Equinox, [Summer Solstice, Autumnal] Equinox and Winter Solstice.
3. Changes of the Moon: New Moon, First [Quarter, Full Moon, Third] Quarter, with the intermediate phases.
4. Solar and Lunar Eclipses—Partial and Total.
5. Philosophy of the Tides; their daily recu[rrence; Spring and Neap] Tides, etc.
6. Precession or falling back of the Equinoxes.
7. Differences of Solar and Sidereal Time.
8. Rising of the Sun north of east in Summer.

Many other things will suggest themselves [to the practical teacher.] The recent improvements in gearing, compass [attachment, finish, etc.,] render this one of the most useful and beauti[ful pieces of apparatus] that any school room or college can possess.

"Really a splendid Chart, explanatory of every geographical term."—*Irish Teachers' Journal.*
"By far the most complete and exhaustive Chart yet published."—*Educational Chronicle.*

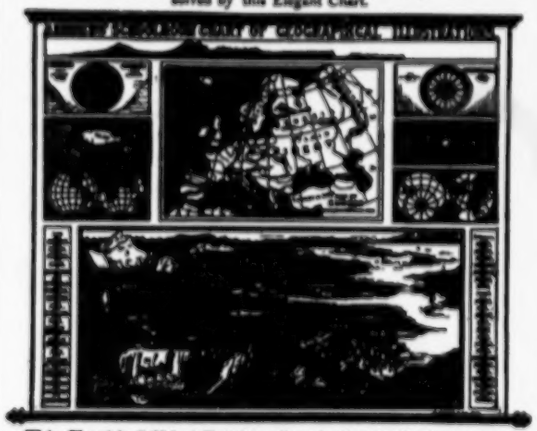
Andrews' School-Room Chart

— OF —

GEOGRAPHICAL ILLUSTRATIONS.

New and Beautiful! Engraved in London!

Just adapted to the the Public School; the Private School; the Family. How to Teach the Rudiments of Geography? The question solved by this Elegant Chart.



This Chart is "Object Teaching," and attracts the immediate attention of the Children.

General Description.

This large Chart, one-half of which resembles a landscape painting, virtually combines Nine Charts in one. The size is 65x54 in.

Every division of **land** and **water**, and all the ordinary **geographical objects** are presented at a glance, saving the time and patience of the teacher. The common physical divisions of land and water are photographed on the mind of the child instantly, and a thousand times more **correctly** and **effectively** than by oral or verbal descriptions alone.

A Tellurian and Geographic chart from Andrew's & Co.'s Illustrated Catalogue (1881) pp. 66-67.

cost from $5 to $10 apiece; under the new system, the price was reduced to a 25¢ to $1 range.[30]

Also, new methods were introduced to care for school maps. In the 1890's, roll-up maps came into vogue. Before, they were placed on a stand and flipped or simply nailed to the wall.

Charts

There was almost no end to the variety of instructional charts advertised during this period. Most were poorly illustrated from cuts but some were quite well-colored and well-organized with a number identification system. Here is a select list of some noted in but one catalogue. All the charts covered eight pages of advertisement:[31]

1. Spencerian Charts of Writing (47 charts mounted on rollers)
2. Johnson's Solar System Chart
3. Johnson's Indestructible Alphabet Chart
4. Monroe's Primary Reading Charts (set of 50)
5. Johnson's Philosophical Charts (set of 10)
6. Andrew's Anatomical and Physiological Charts (handbook 10¢ extra)
7. Wilson and Calkins' School and Family Charts

What were the charts like? They were simply handy references and visual aids for the instructor—comparable to the Atomic Charts in modern day chemistry classrooms. A good example of these charts was "Wilson and Calkins' School and Family Chart." Made up of a set of 22 charts, it embraced such subjects as "Phonic Spelling" (No. 8) to "Economical Uses of Plants" (No. 20). Chart No. 1 was called "First Reading-Lessons." It contained 60 familiar words such as cat, rat, etc., in large type and accompanied by the appropriate colored illustration (copper cut). Thus the child learned to read the word by the picture, even before he knew the letters of the alphabet (if the advertisement is to be believed). The catalogue claimed this to be a " 'NATURE' method, as opposed to the artificial system formerly in vogue."

Arithmetical Apparatuses

Instructional helps for arithmetic and geometry abounded in this period. Object teaching blocks and forms, though certainly nothing new, were used extensively. An 1879 catalogue[32] lists and illustrates

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[30] William Edward Pulsifer, *A Brief Account of the Educational Publishing Business in the United States*, Atlantic City, N.J., 1921, p. 10.

[31] Baker, Pratt & Co., *Illustrated Catalogue of School Merchandise*, New York, 1879, pp. 74–82.

[32] Baker, Pratt & Co., *Catalogue*, 1879, pp. 112–118.

Andrews School Furnishing Company, New York.

McGuffey's Revised Reading Charts.

60 Numbers. 36 x 52 Inches.

Printed on heavy Manilla Paper in clear type. Fully illustrated with well executed original designs.

Adapted to the Object, Letter, Word or Phonic Method, or a combination of these methods.

Multiplication Table, Color Chart, Alphabet in Roman and Script.

Net Price, with Electric Revolving Stand, $9.00.

82

Andrews School Furnishing Company, New York.

Parker's Arithmetical Charts.

Prepared by
FRANCIS W. PARKER,
Principal of Cook County, Ill., Normal School.

Back View of Stand Furnished with Parker's Arithmetical Charts.

These Charts are the best Arithmetical Charts published, and are indispensable in primary class-work.

They present the latest and best methods of teaching beginners in arithmetic, and wherever used will render unnecessary the ordinary text-books in primary arithmetic, thus saving both time and expense.

They have recently been revised, and now comprise 30 numbers, 25 x 30 inches in size.

They are beautifully printed on Manilla Parchment Paper (stronger and more durable than pasteboard), and are compactly bound.

The figures and type were made expressly for these Charts, and are so distinct that they can readily be seen from any part of the class room. The pictures and diagrams were drawn with special adaptation to the lessons.

Among the new features are pictorial representations of linear, surface and cubical measurement, and of the various articles used in determining weight, bulk, volume, etc.

Full and explicit directions are given on the margin of each Chart, so that even the inexperienced teacher may easily understand its use.

Price per Set, with Stand, $9.00.

83

Typical Teaching Charts (Reading and Arithmetical) from Andrews School Furnishing Co. Illustrated Catalogue (New York) 1895, pp. 82-83.

what it called "Set No. 1" of necessary object forms. This set consisted of 30 wooden blocks depiciting every geometric form from a "hexagonal frame" to a "flight of four steps."

From time to time, ingenious but short-lived mathematical instructional aids popped up. For example, the so-called "Gonigraph" was a small instrument composed of a number of flat rods connected by a pivot (in other words, a glorified carpenter's rule) which could show all possible geometrical figures consisting of straight lines and angles (triangles, squares, octagons, etc.).[33]

Numeral frames were advertised regularly. This simple abacus-type apparatus for teaching children to count could be purchased quite cheaply. One, made of 100 colored balls, cost only $1.25 in 1872.[34]

At times, these mathematical apparatuses attained a relative degree of sophistication. As early as 1867, a device was advertised which enabled the teacher to flash whole arithmetic problems to the class with little effort. The apparatus consisted of a number of slots holding number sequences. By manipulating knobs, the teacher could change number combinations and set up problems in "addition, subtraction, multiplication, division, decimals, federal money and reduction."[35] However, simplicity of operation could not have been claimed justifiably—this scholar was unable to figure out exactly how the apparatus worked after two pages of explanation!

Simple calculating machines were being devised and employed in universities and colleges for instructional purposes as early as 1873.

Reading Apparatuses

A number of devices were also invented to aid the child in learning to read. One extremely simple device was the Spelling Stick. It consisted of a grooved piece of wood with a handle on it (like a window washer's squeezer) on which letters were stood upright. Single words or even simple sentences could be formed ("Let Me Try"). The class or individual then read the sentence back to the teacher. The spelling stick cost only 25¢ and a package of letters cost 50¢.[36]

A more complicated apparatus was "Baade's Permutation Reading Case" with a patent date of 1871. Similar to the arithmetical apparatus for flashing class problems mentioned earlier, Baade's device

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[33] *American Journal of Education*, Vol. XVI (1866), p. 377.
[34] National School Furniture Co., *Illustrated Catalogue* (New York?), 1872.
[35] American School Apparatus Co., *Improved School Furniture*, New York, 1867.
[36] Baker, Pratt & Co., *Catalogue*, 1879, p. 118.

The Spelling Stick is a simple device, and most useful for teaching spelling to Primary Classes. It consists of a piece of wood grooved for holding letters, and has a handle as shown in the cut. It is accompanied by letters on cardboard, and is an efficient instrument for instruction in the arrangement of letters and their combination into words. An entire class can be taught by it as readily as a single pupil.

Spelling Sticks, ... Each, $0.25
Fonts of Letters on cardboard for same, in box, ...50

ALPHABET BLOCKS.

						PER SET.
No. 000,	**Flats,**	Natural Wood,	12	pieces, in paper box,	.	$0.10
" 00,	"	"	18	" album "	.	.18
" 0,	"	"	18	" paper "	.	.15
" 1,	"	"	32	" " "	.	.25
" 2,	**Half Cubes,**	"	32	" " "	.	.30
" 3,	**Flats,**	Enameled,	27	" wooden frame box,		.60
" 4,	**Half Cubes,**	Enameled,	27	pieces, in wooden box,		.75
" 5,	"	"	Natural Wood,	24	pieces in wooden frame box,	.45
" 7,	**Illustrated Cubes,**	16	pieces in wooden box,			.60
" 8,	"	"	18	" " "		.90
" 9,	"	"	20	" " "		1.25
" 10,	**Combination Puzzle,**	Building and Alphabet, 32 pieces in wooden frame box,			.	.50
" 11,	**Illustrated Cubes,**	Natural Wood,	16	pieces, plaid, paper box,	.	.40

			PER SET.
No. 14,	**Kindergarten,**	Spelling and Building, Natural wood, 16 pieces in paper box, . . .	$0.20
" 15,	**Kindergarten,**	Natural Wood, 22 pieces in wooden frame box, ...	.40
" 80,	**Illustrated Cubes,**	12 pieces in wooden box,	.65
" 80A,	**Cubes,**	Natural Wood, 12 pieces wooden frame box,	.50
" A,	**Chromatic,**	12 pieces in wooden frame box, .	1.20
" B,	"	12 " " " " " .	.90
" C,	"	9 " " " " " .	.70

Jeffers' Panoramic Apparatus.

For Teaching Reading by Object-Lesson Exercises, with a Manual of Directions.

This is an entirely new apparatus for presenting the first lessons of reading in accordance with an important principle of Elementary Education, namely—*during the first steps let the Child's attention be occupied with a single object only at a time.* By means of this apparatus a picture, a word, or a single letter may be seen at once, or an entire sentence can be shown at the same time. It can be quickly changed and adjusted to a letter, word, or sentence by the teacher, or even by the youngest pupil in school. The type is so large and plain that the words can be easily read across a room twenty-five feet in width. The words and objects are illustrated by large colored pictures, which may be seen by fifty pupils at the same time. By means of this apparatus, and a good blackboard, a class of fifty children may be taught to read several hundred words that are in common use, at sight; also sentences containing words of two and three syllables, within two months. Its use is highly interesting to the pupils, by combining amusement with instruction. Price, ... $15.00

Jeffer's Panoramic Apparatus and The Spelling Stick from Baker, Pratt & Company, Catalogue, New York (1879) pp. 118-119.

NO SCHOOL SHOULD BE WITHOUT

A SET OF

HARRINGTON'S GEOMETRICAL BLOCKS,

(Patent applied for,)

THE ONLY SIMPLE AND YET COMPREHENSIVE SYSTEM

OF

OCULAR MENSURATION.

Every Geometrical Formula accurately demonstrated.

Every form, however irregular, so hinged as to enable the teacher to dissect it before the pupil, and show "*the reason why*" of each rule for measurement.

By the use of these blocks, the pupil who is acquainted with the common rules of Arithmetic may, in a few hours, learn to measure any surface or any solid.

Price per Set, ... *$10 00*

Prof. H. A. NEWTON, Prof. Mathematics in Yale College, says:

Mr. Harrington has shown me a series of blocks intended to assist teachers in illustrating the rule of Mensuration wherever given in Arithmetics without demonstration. The blocks correctly illustrate the reason of the rules, and in the hands of an intelligent teacher would, I think, be very valuable.

CHAS. DAVIES, LL.D., author of "Davies' Complete Mathematical Course," says:

They are thoroughly accurate and simple—just the thing for every school-room.

STATE OF CONNECTICUT, OFFICE OF SECRETARY OF BOARD OF EDUCATION, *State House, New Haven, May 19, 1871.*

DR. I. HARRINGTON'S Geometrical Blocks for the illustration of the rules of Mensuration seem to me to be the simplest and best yet invented. They make plain what many scholars fail to comprehend.

B. G. NORTHROP, *State Superintendent of Education.*

NUMERAL FRAMES.

No. 1. 144 Colored Balls, ... *$1 50*

" 2. 100 " 1 25

SEND FOR A PRICE LIST.

BAADE'S PERMUTATION READING CASE.

Patented August 22, 1871.

CONTAINING **20,000 Sentences,** which can be INSTANTANEOUSLY CHANGED.

OBJECT AND **Word Method** PRACTICALLY AND Attractively Combined.

THIS apparatus consists of a neatly finished black walnut case, and a set of *thirteen large printed cards*. The frame is arranged with three vertical tiers of small slides upon the front, which may be easily moved up or down at pleasure. To prevent their becoming loose and inoperative, small springs are placed in the ends of each, which press lightly in the grooves in which they work. Upon the cards, which are contained in a receptacle behind the slides, are printed in large distinct type, that may be easily read across the school-room, three columns of ten words each, spaced to correspond with the slides in front. The slides are arranged so as to show *but three words upon the card at a time*, which always form a sentence, in whatever position the slides may be left. *From each side of every card 1000 sentences may be formed*, and the change from one to another *is instantaneous*. Upon the upper portion of the Card, which is always in view, are cuts of *objects, animals, etc.*, which illustrate the exercises and enhance their interest. As a device to facilitate the instruction of primary classes in learning to read, no other apparatus has been invented that so practically meets the purpose designed. It is simple, convenient, and inexpensive. It is always ready for use, and is so constructed that it can never get out of order.

Price, ... $10 00

SEND FOR A PRICE LIST.

One of Many Types of Reading Cases and Devices (Baades' Permutation Reading Case) The National School Furniture Co. Illustrated Cataloque New York (L872) p. 35.

consisted of a wooden frame encasing three wooden slots. Instead of numbers, there were words illustrated by cuts of animals, etc. Thus the teacher could flash individual words or whole sentences for the class to read. According to the advertisement, the device had a capability of 26,000 sentence combinations.[37]

Going a step further was "Jeffer's Panoramic Apparatus" of 1879. With this device, a picture, word, single letter, or entire sentence was depicted in a slot for the class to identify. The difference between this apparatus and its predecessors was that it was entirely mechanical. The teacher did not have to insert separate cards with words or pictures on them. Instead, two cranks at the side of the machine rolled the picture or object into view. As the company pointed out, "It can be quickly changed . . . by the teacher, or even by the youngest pupil in school."[38]

Other Educational Materials

There were other educational materials in use during this period and even though they promised no innovation or technological impact on education, they might be mentioned in passing. Here is a select list of some in vogue near the turn of the century according to an educational manual of the times:[39]

1. Language builder-boxes of letters or words
2. Geometrical blocks
3. Clay and wax modeling materials
4. Peg-boards
5. Embroidery design cards
6. Paper weaving, folding, and cutting materials
7. Number tablets (black with dots like dominoes)
8. Figure cards (similar to playing cards)
9. Object cards
10. Clock dials
11. Toy money
12. Colored fraction disks
13. Alphabet blocks

Textbooks

Innovations in Printing

As was mentioned before, the practice of printing from movable type had become obsolete by the 1840's, being replaced by stereotyping. About 1860, a new process called electrotyping was introduced. In

[37] National School Furniture Co., *Illustrated Catalogue*, 1872, p. 35.
[38] Baker, Pratt & Co., *Catalogue*, 1879, p. 119.
[39] Milton Bradley Co., *Helps for Ungraded Schools: A Manual for the Use of Educational Material*, Springfield, Massachusetts, 1890.

this process an impression of the type was made in wax. Then a thin shell of copper or nickel was deposited in this mold by electrolytic process, and melted type-metal was then cast into the back of the sheet. In this way the plate for printing was made.[40]

This plate was more resistant to wear than stereotyped plates, thus it was especially suited to the textbook industry which printed large editions. The plate also reproduced wood engravings more clearly. With these advantages, it was not long before electrotyping completely replaced stereotyping.

Also there was an important innovation in the press itself. Until approximately 1875, the Adams or flat press was used. Then in 1860, William Bullock began to experiment with a rotary self-feeding or web printing press. He finally achieved success in 1865. This new web rotary press could turn out ten times as much work as the flat-bed press in the same amount of time.[41] However, it should be pointed out that this improvement took time to work its way into the textbook industry. As late as 1890, the Adams flat-bed press was still being used by Ginn and Company.[42]

Binding of Texts

As early as 1856, Cyrus Chambers took out a patent on folding machines. However, it was not until about 1875 that they were widely used. The first patent on a rounding and backing machine was filed in 1888. Sewing machines and case-making machines were being developed in the 1880's, but were not perfected until 1900. Gathering machines became practical about 1893.[43]

While this era produced some improvements in text-binding, no real benefits were reaped until after the turn of the century.

Illustrations

Illustrative material steadily improved during this period. Photography began to make its weight felt with the advent of the half-tone process in the 1880's. This in turn gave rise to a completely new method of printing—offset printing. Color was introduced by Frederick Ives of Philadelphia in 1881, but it was 40 years before it was fully developed and used in schoolbooks. Not until late in the nineteenth century [44] were cover designs introduced and used.

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[40] Hellmut, Lehmann-Haup, *op. cit.*, pp. 132–133.
[41] William Edward Pulsifer, *A Brief Account of the Educational Publishing Business in the United States*, Atlantic City, N.J., 1921, p. 9.
[42] Thomas Bonaventure Lawler, *Seventy Years of Textbook Publishing: A History of Ginn and Company*, New York: Ginn and Co., 1938, p. 86.
[43] Lehmann-Haup, *op. cit.*, pp. 122–126.
[44] Pulsifer, *op. cit.*, pp. 8–9.

The Magic Lantern and Stereoscope

The magic lantern was a device which was an audio-visual aid in the strict modern sense of the word. For this reason, it has been purposefully left to the last for discussion. From the first, it demanded a high degree of technology. This put it in a class apart from other school apparatus which could be improvised by the teacher himself if need be. It also represented a high increment of scientific knowledge. Once completed, it represented a sizable financial investment (as the schools were to find out!). In short, a real industrial revolution was forcing itself upon education.

The origins of the magic lantern reach far back into antiquity. Anthanasius Kircher is credited with the first demonstration of a magic lantern in Rome in 1646. It was then used for two centuries around Europe as a novel entertainment medium.

The marriage of photography and projection principles produced, as an offspring, an interim visual aid for education—the stereoscope. Utilizing two photographs and a simple optical apparatus, the stereoscope permitted a viewer to see a third dimension. Its possibilities for application in the field of education were perceived almost immediately.

As early as 1856, Sir David Brewster, who had pioneered certain fields of stereoscopic research, wrote a book urging educators to adopt this visual aid to education.[45]

Maligning the old system of education he said:

> . . . the existing system is utterly inefficient. The teacher . . . may pour it in the ear, or extract it from the printed page, or exhibit it in caricature in the miserable embellishments of the school-book, but unless he teaches through the eye . . . no satisfactory instruction can be conveyed.[46]

He foresaw several uses for the stereoscope in education:

1. instruction of geography
2. art instruction
3. to illustrate nature, animals, minerals, etc.
4. to illustrate diagrams.

The stereoscope became quite popular in the United States, not only in the school for instruction, but also in the parlor for entertainment. Much of the credit for popularizing the stereoscope in the United States must go to none other than Oliver Wendell Holmes.

This increased interest in photography germinated the next logical step in visual education—projection of these photographs. Thus the

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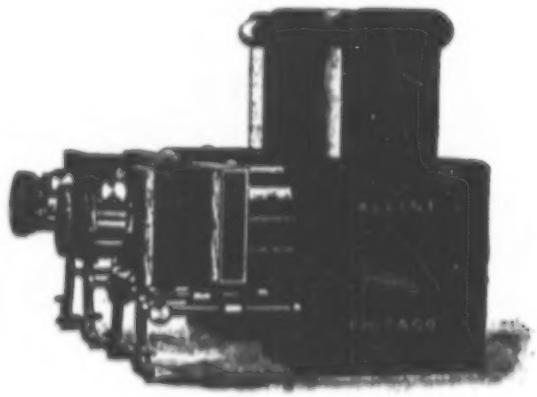
[45] Sir David Brewster, *The Stereoscope: Its History, Theory, and Construction With Its Application to the Fine and Useful Arts and to Education*, London: John Murray, 1856.
[46] *Ibid.*, p. 195.

THE "CHALLENGE" OIL LIGHT DISSOLVING LANTERN.

No. 800.



No. 800, Consists of a pair of No. 700 "Challenge" Oil Light Lanterns placed side by side on a polished mahogany base, with lenses matched for dissolving views, fitted with a universal dissolver. Packed in wooden carrying case. Price $80.00

No. 800A, Same as No. 800, but with *four* wick lamps. Packed in wooden carrying case. Price..... 90.00

Study the style and prices of the . . .

...ECONOMIC CHALLENGE...

. . . As listed on pages 16 and 17.

THE SCIOPTICON. No. 810.

No. 810. The Sciopticon is made of Russia iron, has 4-inch condensers, good quality object glasses, with rack and pinion, and will make a clear disc of 6 feet in diameter. Packed in Russia iron carrying case. Price.....$32.50

THE SCIOPTICON. No. 820.

No. 820. Is very similar to No. 810, but has a japanned tin body in place of Russia iron, otherwise No. 820 will do the same work as No. 810. Packed in wooden carrying case. Price $20.00

Magic Lanterns and Sciopticons from O.B. & G., Kleine & Co. Illustrated Catalogue, Chicago (1894) pp. 20-21.

magic lantern, or stereopticon, was a sought-after apparatus by the more progressive schools.

As was said before, even the simplest of these projectors required a much higher investment than the users of school apparatuses were accustomed to. An 1874 catalogue [47] advertised its cheapest magic lantern at $25; a stereopticon might run as high as $325. Also, there were other expenses involved. Sources of light for the projection process were from oil, hydrogen, and calcium (electricity did not come into existence until the Edison Arc of the 1890's). The cost of the gaseous light sources ran about $1.25 for every two hours' exhibition. Then there were other necessary accessories such as screens, costing from $6 to $14. Slides averaged about $1.25 apiece (a complete set running from $50 to $100).

Regardless of the cost and the necessity of operator training, the slide projector was immediately recognized by the world of education as the vanguard of a new field of visual aids. A writer for an education journal [48] near the turn of the century expressed the common attitude:

> The age of illustration is now with us and illustrate we must if we expect to gain and to hold the attention of young and old. . . . No one can predict the limits of education through this wonderful advance in photography, and no one can deny the immediate expediency of adopting such an auxiliary in the schools.

A catalogue of 1894 [49] revealed the industry's recognition of the educational possibilities of this visual medium. One advertised set of slides included 28 different maps of the world for instructional purposes. Various series of American and European history slide sets also in the catalogue indicated early recognition of the value of visual aids . From this pioneer visual aid apparatus, there developed after 1900 a number of educational devices based directly or indirectly on the same principle—the filmstrip in the 1920's, microfilm in the 1930's, and the tachistoscope in the 1940's—not to mention the obvious contributions to the motion picture industry. From its earliest beginnings, the lantern projector was a voice in the wilderness prophesying a real technological revolution in education. And yet, even this device had no great impact on education in its own era. Thus, with the advantage of historical hindsight, we can safely observe that technology from the colonial period to 1900 made very few inroads into the field of education. The real revolution was yet to come.

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[47] James W. Queen & Co., *Priced and Illustrated Catalogue of Magic Lanterns, Stereopticons*, etc., New York, 1874.

[48] W. F. C. Morsell, "The Lantern in the School," *Education*, Boston, Vol. XIII, May 1893, pp. 558–559.

[49] O. B. & G. Kleine Co., *Complete Illustrated Catalogue of Stereopticon, Sciopticons, Magic Lanterns*, etc., Chicago, 1894.

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